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THE SUITABILITY OF USING AN
EVOLUTIONARY ACQUISITION STRATEGY IN
JOINT ACQUISITION PROGRAMS FOR
COMMAND AND CONTROL SYSTEMS

A thesis presented to the Faculty of the U.S. Army
Command and General Staff College in partial
fulfillment of the requirements for the
degree

MASTER OF MILITARY ART AND SCIENCE

by

SAMUEL A. ROBINSON JR., MAJOR, USAF
B.Eng., Stevens Institute of Technology, 1974
M.B.A., University of Missouri, 1978
M.S., Air Force Institute of Technology, 1981

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The purpose of this study is to determine the suitability of using an evolutionary acquisition strategy in joint acquisition programs for command and control systems. The policies of the Office of the Secretary of Defense and of the Joint Logistics Commanders support the use of an evolutionary acquisition strategy in acquiring command and control systems. At the same time, these policies note that the unique circumstances of individual programs should be considered. This study examines the unique circumstances of joint acquisition programs and relates these circumstances to the evolutionary acquisition of command and control systems.

This study has two conclusions. First, the Packard Commission's criterion -- an informed trade-off between user requirements, on the one hand, and schedule and cost, on the other -- is (of several sets of criteria presented) the only one upon which to base a decision on the research question. Second, on the research question itself -- the suitability of using an evolutionary acquisition strategy in joint acquisition programs for command and control systems -- based on the Packard Commission's criterion, the conclusion is: No, an evolutionary acquisition strategy is not suitable to use in joint acquisition programs for command and control systems.

This study has two recommendations. First, the policies relative to evolutionary acquisition and the policies relative to joint acquisition must consider the effects of each. That is, any evolutionary acquisition policy must consider the unique challenges faced by a joint acquisition program; and the corollary -- any joint acquisition policy affecting command and control systems must consider the special attributes of these systems. Second, since the rules for an evolutionary approach do not accommodate the day-to-day realities of program management, further study must focus on how to make the accommodation happen. *Regard, etc.*

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Programs for Command and Control Systems

Approved by:

John T. Duckett III, Thesis Committee Chairman
Major John T. Duckett III, M.S., M.B.A.

Robert L. Tipton Jr., Member, Graduate Faculty
Lieutenant Colonel Robert L. Tipton, Jr., M.S.

Catherine H. T. Foster, Member, Consulting Faculty
Colonel Catherine H. T. Foster, Ph.D.

Accepted this 2nd day of June 1989 by:

Philip J. Brookes, Director, Graduate Degree
Philip J. Brookes, Ph.D. Programs

The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

THE SUITABILITY OF USING AN EVOLUTIONARY ACQUISITION STRATEGY IN JOINT ACQUISITION PROGRAMS FOR COMMAND AND CONTROL SYSTEMS. by Major Samuel A. Robinson Jr., USAF. 136 pages.

The purpose of this study is to determine the suitability of using an evolutionary acquisition strategy in joint acquisition programs for command and control systems. The policies of the Office of the Secretary of Defense and of the Joint Logistics Commanders support the use of an evolutionary acquisition strategy in acquiring command and control systems. At the same time, these policies note that the unique circumstances of individual programs should be considered. This study examines the unique circumstances of joint acquisition programs and relates these circumstances to the evolutionary acquisition of command and control systems.

This study has two conclusions. First, the Packard Commission's criterion -- an informed trade-off between user requirements, on the one hand, and schedule and cost, on the other -- is (of several sets of criteria presented) the only one upon which to base a decision on the research question. Second, on the research question itself -- the suitability of using an evolutionary acquisition strategy in joint acquisition programs for command and control systems -- based on the Packard Commission's criterion, the conclusion is: No, an evolutionary acquisition strategy is not suitable to use in joint acquisition programs for command and control systems.

This study has two recommendations. First, the policies relative to evolutionary acquisition and the policies relative to joint acquisition must consider the effects of each. That is, any evolutionary acquisition policy must consider the unique challenges faced by a joint acquisition program; and the corollary -- any joint acquisition policy affecting command and control systems must consider the special attributes of these systems. Second, since the rules for an evolutionary approach do not accommodate the day-to-day realities of program management, further study must focus on how to make the accommodation happen.

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CHAPTER 1

EVOLUTIONARY ACQUISITION

OF

COMMAND AND CONTROL SYSTEMS

Introduction

The purpose of this study is to determine the suitability of using an evolutionary acquisition strategy in joint acquisition programs for command and control systems. The policies of the Office of the Secretary of Defense and of the Joint Logistics Commanders (1,2) support the use of an evolutionary acquisition strategy in acquiring command and control systems (3,4). At the same time, these policies note that the unique circumstances of individual programs should be considered. This study examines the unique circumstances of joint acquisition programs and relates these circumstances to the evolutionary acquisition of command and control systems.

Why is this study important? As the President's Blue Ribbon Commission on Defense Management states, "Chances for meaningful improvement [in the defense acquisition system] will come not from more regulation but only with major institutional change." (5) The use of an evolutionary acquisition strategy represents such an

institutional change in the traditional acquisition process (albeit not a "major" change). Whether use of such a strategy provides for meaningful improvement in joint acquisition programs so as to lead to successful programs is the thrust of this study.

This chapter is a short primer to place evolutionary acquisition of command and control systems in the context of the acquisition process. First, this chapter contains a definition of several terms germane to this study -- joint acquisition programs, command and control systems, and evolutionary acquisition. Second, this chapter provides a background on the nature of command and control systems as related to an evolutionary acquisition approach. And third, this chapter concludes with a discussion of this study's significance, limitations, and methodology.

Definition of Terms

Several terms -- joint acquisition programs, command and control systems, and evolutionary acquisition -- need clarification.

Joint Acquisition Programs. According to DOD Directive Number 5000.45, an acquisition program is

a directed effort for the development of systems, subsystems, equipment, software, or munitions as well as supporting equipment, systems, or projects, with the goal of providing a new or improved capability for a validated need (6).

And a joint program, according to the Joint Logistics Commanders,

is one in which two or more services are participating in the development and acquisition of a weapon system. In such a program, the services may ultimately buy the same item or variants of an item to reflect service-specific needs, missions, and requirements (7).

Joint acquisition programs have a variety of structures ranging from a single service program with other services indicating interest to a multiservice program with a fully integrated joint program office (8). The classic, or traditional, acquisition process has five distinct phases: Concept Exploration/Definition; Concept Demonstration/Validation; Full-Scale Development; Production/Deployment; and Operation and Support. Milestone decisions by the DOD or service acquisition executive precede each phase. Vital to a program's success is the documentation necessary to support system configuration, program status, test activities, and logistics support (9). Acquisition programs encompass a variety of systems, one of which is command and control systems.

Command and Control Systems. By Joint Chiefs of Staff (JCS) Publication 1, a command and control system consists of

the facilities, equipment, communications, procedures, and personnel essential to a commander for planning, directing, and controlling operations of assigned forces pursuant to the missions assigned (10).

A command and control system example is the Worldwide Military Command and Control System (WWMCCS). The

WWMCCS provides the means for operational direction and technical administrative support involved in the function of command and control of US military forces. The WWMCCS has five basic elements: (i) warning systems, (ii) WWMCCS communications, (iii) data collection and processing, (iv) executive aids, and (v) WWMCCS command facilities. These five elements support four basic functions of higher-echelon military command and control: (i) nuclear planning and execution, (ii) tactical warning and attack assessment, (iii) resource and unit monitoring, and (iv) conventional planning and execution (11,12).

With respect to command and control terminology, which in many cases is quite ambiguous, the Army Command and Control Master Plan (among many other sources) clarifies some of the confusing acronyms used here:

The term "C2" is often used as shorthand for the entire decisionmaking and direction process. But as such, it is really a misnomer because the underlying concept must subsume communications and intelligence. Thus "C2" almost always means "C3I" because together they are a fundamental, holistic concept involving four interdependent processes and systems [command, control, communications, intelligence] (13).

In relation to a system for command and control, this study addresses those command and control system elements amenable to materiel acquisition by the DOD -- facilities, equipment, communications, and not procedures and personnel. Such "hardware" and "software" systems (forming facilities, equipment, and communications)

generally include sensor arrays, communications links, command and control facilities, and processing and display equipment (14).

But again, that concept for command and control system elements is still too broad, since the sensor, for example, on the end of a tactical missile is not really the issue. To further describe the focus of this study, Defense Acquisition Circular #76-43 provides a perspective on the systems procured through command and control systems acquisition:

The types of systems that augment the decision-making and decision executing functions of operational commanders and their staffs in the performance of C2. . . . The principal characteristics of such systems are: (1) acquisition cost is normally software dominated; (2) the system is highly interactive with the actual mission users and is highly dependent on the specific doctrine, procedures, threat, geographic constraints, and mission scenarios of these users; and (3) these systems are characterized by complex and frequently changing internal and external interfaces at multiple organizational levels, some of which may be inter-Service and multinational (15).

Evolutionary Acquisition. This is an alternative strategy which may be used to acquire command and control systems just described. DOD currently has two policy statements on evolutionary acquisition. An analysis of the descriptions of evolutionary acquisition from each statement shows the relative consistency within DOD as to what evolutionary acquisition means.

First, from the Office of the Secretary of Defense, Defense Acquisition Circular #76-43 (22 March 1983), an evolutionary acquisition approach

is an adaptive, incremental approach where a relatively quickly fieldable "core" (an essential increment in operational capability) is acquired initially. This approach also includes with the definition of the "core capability": (1) a description of the overall capability desired; (2) an architectural framework where evolution can occur with minimum subsequent redesign; and (3) a plan for evolution that leads towards the desired capability. . . . Subsequent increments must be based on continuing feedback from operational use, testing in the operational environment, evaluation and (in some cases) application of new technology. Operational and interface requirements and operational utility criteria should be evolved with the participation of actual mission users (or lead user and appropriate user surrogate for multi-year systems). There must be regular and continual interaction with developers, independent testers, and logisticians (16).

Second, the Joint Logistics Commanders Guidance for the Use of an Evolutionary Acquisition (EA) Strategy in Acquiring Command and Control (C2) Systems (March 1987) progresses from the definition four years earlier in Defense Acquisition Circular #76-43 and elaborates on succeeding increments:

Evolutionary acquisition is an acquisition strategy which may be used to procure a system expected to evolve during development within an approved architectural framework to achieve an overall system capability. An underlying factor in evolutionary acquisition is the need to field a well-defined core capability quickly in response to a validated requirement, while planning through an incremental upgrade program to eventually enhance the system to provide the overall system capability. These increments are treated as individual acquisitions, with their scope and content being the result of both continuous feedback from developing and

independent testing agencies and the user (operating forces), supporting organizations, and the desired application of new technology balanced against the constraints of time, requirements, and cost (17).

There are a number of reasons why such a strategy came about. The next section explores a few of those reasons.

Command and Control Systems and Evolutionary Acquisition

A trend engulfs the military today: "information" is displacing the traditional sources of power and control (18). Changing too, by virtue of that trend are the systems which bring that information to the commander. As General John A. Wickham, Jr., USA (Ret) (in 1989, former Army Chief of Staff), writes,

Communications and computing machinery has migrated out of the direct control of specialists and onto the desk tops of users, who increasingly have the knowledge, the money and the clout to play a dominant role in the design and acquisition of new information systems (19).

These new information systems play an ever increasing part in the national security strategy of the United States and its allies because that strategy relies on exploiting electronic sensors and automated information information systems to leverage smaller, more effective, and less expensive combat forces (20).

A gap continues to exist, however, between what the developer -- the specialist -- produces to exploit technology and the performance the user needs to leverage forces, since the inception some twenty-five years ago of

modern command and control systems. Because of the nature of command and control systems, two reasons for the gap exist.

The first reason is change. The reality of command and control systems is change -- whether through experience, or from situations (new users, systems, threats, missions), or by technology (obsolete to feasible). Another reality is the very large number of components in the system and of participants in the process, both of which contribute to the difficulties in acquiring command and control systems (21).

The difficulty in dealing with the participants begins with the commander: "one commander's bare essentials are another's gold plating." (22) In other words, the sensor arrays, communications links, command and control facilities, and processing and display equipment are not the central ingredient of what is referred to as a command and control system; but, unique to command and control systems among DOD's materiel acquisitions, the commander with staff and pertinent doctrine and procedures is the central, and indeed dominant, ingredient (23). As a result, the design, and eventual acquisition, of command and control systems must accommodate considerable variation in style and need (24).

A second reason why the gap exists is because of the difficulty in analyzing command and control systems due to the unpredictability of circumstances and human behavior

interacting with complex sensors, communications systems, command centers, and weapons (25). Dr. George H. Heilmeier (in 1986, former Director of the Defense Advanced Research Projects Agency) proposes there are at least five aspects to the problem of command and control systems, and these aspects impact on command and control system acquisition: (i) the gap between the engineers and the operators is large; (ii) even within the engineering side, another gap ensues as command and control systems technology requires a synergistic relationship (which remains elusive) among computer science, systems and information science, and communications; (iii) regardless of reasons, insufficient data in command and control system development decisions causes a "buy before try" approach without adequate performance measures; (iv) those decisions yield point solutions that inhibit flexibility to grow gracefully the technology in response to change; and (v) across the board, command and control systems programs tend to ignore human interface questions (26).

Consequently, one concept advanced to address those two reasons which link the unpredictable, changing environment of human decision-making and the acquisition of command and control systems is a scheme called evolutionary acquisition. It is both intrinsically evolutionary and inherently flexible in the definition of both system requirements and end-item capabilities (27). This concept

(evolutionary acquisition of command and control systems) dates back to Air Force requirements of the 1965 period; offers a mechanism to provide, somewhat, for the unpredictability of people and force structure; and reflects, basically, the way complex systems change (28,29).

As Admiral William J. Crowe, Jr. (current Chairman of the Joint Chiefs of Staff), comments,

There must be evolutionary introduction of new technology to upgrade existing command and control system capabilities rather than revolutionary replacement of entire systems [original emphasis] (30).

First, Admiral Crowe's admonishment to support evolutionary rather than revolutionary reflects a fundamental premise of the change process: what is the relationship between the type of technology developed and the manner in which that technology is acquired? What that impacts on the ultimate success of the acquisition program. From force structure analysis, for technology supporting command and control systems, a theoretical basis exists to show that an acquisition approach based on evolutionary development is more appropriate (31). Besides an evolutionary method, other alternative methods exist based on phased, incremental, and turnkey approaches. A phased approach is a sequenced, design series whose requirements were established in the beginning; an incremental approach is a series whose steps only partially address the requirement; and a turnkey approach is delivery

of a complete system. The evolutionary acquisition approach provides, however, a flexible initial system for eventual upgrade (32).

Second, though by nature unpredictable, certain force structure facts drive command and control system designs and their acquisition: (i) joint and combined land-air-sea-space operations; (ii) rapid deployment force operations; (iii) ground/air-sea/undersea space management (fratricide and safety); (iv) dispersed and decentralized command and control; (v) high technology threats (like cruise missiles); and (vi) high maneuver tactics (33).

These command and control system design facts cover functions inherent, not only in joint command and control systems, but in all those command and control systems having joint implications (34). Those force structure facts, in turn, have major system design implications like: (i) information demands due to high volumes, time sensitivity, extensive flow, processing, fusion, and correlation; and (ii) "ilities" such as joint and allied interoperability, and command and control systems survivability (35).

To compound the unpredictable nature of command and control systems, with respect to procedures and personnel, how the data and how its contents are presented varies with the organization and the style of the commander, who rotates regularly. This impacts on the design of the information system (36).

Finally, a study by the Armed Forces Communications and Electronics Association proposes the following benefits accrue to DOD from the use of an evolutionary acquisition strategy to acquire command and control systems:

- A measurably increased command and control capability in the hands of users, achieved far sooner than if DOD waited for a one-time "total" solution, due to the incremental, user-oriented development approach.
- Greater user satisfaction with, and more rapid assimilation of, systems resulting from the evolutionary command and control system acquisition process, as a result of the user's close and continuous coupling with the acquisition, and the smaller, more-frequently-fielded increments that the user will receive.
- Reduced government risk and exposure, since each increment is limited.
- Easier technology insertion, and hence reduced obsolescence of materiel in the field, due to an architecture and approach to design aimed at readily accommodating change.
- Longer useful life of command and control systems, also resulting from an architecture that readily accommodates change (37).

Despite those benefits, for command and control systems, there are only a few acquisition programs known to use an evolutionary acquisition strategy. They include the Army's Advanced Field Artillery Tactical Data System, the Army's Combat Support System, the Air Force's Global Decision Support System (in support of the Military Airlift Command), and elements of Worldwide Military Command and Control System (WWMCCS) like the WWMCCS Information System and like the upgraded systems for the North American Aerospace Defense Command (38,39,40,41).

In summary, based upon the nature of command and control systems, one concept advanced -- evolutionary acquisition -- attempts to bridge that gap between what the developer produces to exploit technology and what the user wants to leverage forces. Command and control systems typically involve decision-making and decision-executing activities. Changing, and somewhat unpredictable, these systems have numerous complex external and internal interfaces; have difficulty to define measures of worth that are highly dependent on the specific doctrine, procedures, threat, geographic constraints, mission scenarios, and management approaches of specific mission users; and are software-dominated, with the software highly interactive with the cognitive processes of commanders and their staffs. (As a result, communications systems and sensors normally would be excluded.) (42)

Significance of Study

As stated earlier, the use of an evolutionary acquisition strategy represents an institutional change in the traditional acquisition process. Whether use of such a strategy provides for meaningful improvement in joint acquisition programs so as to lead to successful programs is the thrust of this study.

But why now? Despite two relatively recent major initiatives by, respectively, the executive and legislative branches of the federal government, questions remain as to

the implementation of those initiatives. The final report to the President by the President's Blue Ribbon Commission on Defense Management -- the Packard Commission -- presents detailed findings, conclusions, and recommendations on defense acquisition (among three other subjects).

Essentially, the Packard Commission finds acquisition programs (in general) too long and too costly; moreover, these programs fail to perform as expected and exhibit chronic instability (43). Meanwhile, the Goldwater-Nichols Department of Defense Reorganization Act of 1986 represents current Congressional interest in modifying user/developer roles (a key in evolutionary acquisition) by elevating the "joint" role in operations while at the same time solidifying the "civilian" role in acquisition (44).

The significance of this study lies in whether a relatively unique strategy (evolutionary acquisition) is suitable to use with an equally unique set of circumstances (joint acquisition programs for command and control systems) given, in particular, the results of the Packard Commission.

At the same time, despite the fact that the majority of command and control systems' acquisition programs are joint acquisition programs, one wonders why evolutionary acquisition, as a current DOD policy, is not more widely applied. Perhaps some acquisition approaches, which are valid and work well within a single department, do not function the same way in the joint environment.

Evolutionary acquisition of command and control systems may, or may not be, one of those acquisition approaches. The purpose of this study is to address this issue by examining the suitability of using an evolutionary acquisition strategy in joint acquisition programs for command and control systems.

Limitations

The range of current practices with respect to joint program execution is extremely broad. Such topics as funding, contracting, logistics planning, testing, production planning, program control, architecture, systems planning, interoperability, and others could all be examined in depth. The limitations of time and of resources imposed on this study permit only a cursory look at many of these issues. As a result, this study addresses those topics from an aggregate perspective and omits detailed analysis of their influences or their impact. In addition, this study will neither conduct detailed interpretation or analysis of mathematical models nor extend to earlier than 1976.

Methodology

The methodology used in this study is a systematic process of analyzing evolutionary acquisition (a "strategy") and joint acquisition (a "program") to find any significant disconnects when the two are brought together. The crux of the methodology is the combining of information from various sources to reveal new conclusions. In doing that combining,

this study explores aspects of evolutionary acquisition not widely known and, in parallel, aspects of joint acquisition not previously studied.

Chapter one provides an overview of the nature of command and control systems and of the related acquisition strategy of evolutionary acquisition.

Chapter two reviews the major DOD studies pertinent to command and control systems management and to joint acquisition program management.

Chapter three examines the basis for both evolutionary acquisition and joint acquisition and concludes with a criterion determined relevant to assessing the suitability of using an evolutionary acquisition strategy in joint acquisition programs for command and control systems.

Despite the existence of such a relevant criterion necessary to address the purpose of this study, the question remains, is the criterion sufficient? To see whether other criteria emerge, chapter four, using nine "inherent conflicts" in evolutionary acquisition, examines whether they, too, serve as additional criteria in determining the suitability of using an evolutionary acquisition strategy in joint acquisition programs for command and control systems.

Chapter five draws conclusions based upon the criterion presented in chapter three and upon those criteria determined relevant in chapter four and makes recommendations based upon those conclusions.

CHAPTER 1 -- ENDNOTES

1Joint Logistics Commanders, Joint Logistics Commanders' Guide for the Management of Joint Service Programs, 3rd ed. (Fort Belvoir, VA: Defense Systems Management College, 23 September 1987), p. i. The Joint Logistics Commanders are together the:

- Commander, US Army Materiel Command,
- Deputy Chief of Naval Operations (Logistics),
- Commander, Air Force Logistics Command, and
- Commander, Air Force Systems Command.

2Major Harold E. Thompson, Jr., USAF, Joint Service Activities: Trends and Implications, Study Project Report, PMC 76-1 (Fort Belvoir, VA: Defense Systems Management School, May 1976), pp. 3-4. According to Major Thompson, since 21 June 1966, when a Memorandum of Agreement established the Joint Logistics Commanders umbrella organization, the activities under the auspices of the Joint Logistics Commanders have met broad objectives:

- To prevent duplication among the services by joint utilization, intelligence, facilities, equipment, supplies, and services in all cases where military effectiveness and economy of resources will thereby be increased; and
- To conform to uniform policies and standardization on material and logistics concepts, system design, forms, terminology and criteria for the procurement, requisition, storage, transportation, distribution, issue and maintenance of weapon systems, supplies, and equipment consistent with the specialized needs essential to effective functioning of each command.

3Richard D. DeLauer, The Under Secretary of Defense (Research and Engineering), "Acquisition Management and System Design Principles," 28 February 1983; with attachment: Defense Acquisition Circular #76-43, 22 March 1983, pp. 8-9. Defense Acquisition Circular #76-43 to the 1976 edition of the Defense Acquisition Regulation (Armed Services Procurement Regulation) still represents DOD policy according to DOD Directive 5000.2, Defense Acquisition Program Procedures, 1 September 1987, p. 2-2.

4Joint Logistics Commanders, Joint Logistics Commanders Guidance for the Use of an Evolutionary Acquisition (EA) Strategy in Acquiring Command and Control (C2) Systems (Fort Belvoir, VA: Defense Systems Management College, March 1987), p. 1.

5Committee on Armed Services, United States House of Representatives, 100th Congress, Defense Acquisition: Major U.S. Commission Reports (1949-1988) (Washington, DC: GPO, 1 November 1988), p. 923. Reference here is to the Packard Commission (1986): A Quest for Excellence -- Final Report to the President by the President's Blue Ribbon Commission on Defense Management.

6Department of Defense, Directive Number 5000.45, Baselining of Selected Major Systems (Washington, DC: GPO, 25 August 1986), p. 1-1.

7Joint Logistics Commanders, Guide, op. cit., p. E-2. This Guide also defines "Joint Acquisition Program" to be similar to that of "Acquisition Program" found in DOD Directive 5000.45: "A directed joint effort for the development and procurement . . . for a validated joint need."

8Ibid., p. 1-1.

9Army Command and Management: Theory and Practice (Carlisle Barracks, PA: U.S. Army War College, 26 August 1988), pp. 17-19, 17-20.

10Joint Chiefs of Staff, JCS Pub. 1, Department of Defense Dictionary of Military and Associated Terms (Washington, DC: GPO, 1 June 1987), p. 77.

11The Joint Staff Officer's Guide, AFSC Pub. 1 (Norfolk, VA: Armed Forces Staff College, 1 July 1988), pp. 116-120, 260-264.

12"Worldwide Military Command and Control Information System," C3I Handbook, 3rd ed., by the eds. of Defense Electronics (Palo Alto, CA: EW Communications, Inc., 1988), pp. 83-90.

13Combined Arms Combat Developments Activities Army Command and Control Master Plan, 2 vols. (Washington, DC: Defense Technical Information Center, October 1987), v. I, p. 2-6.

14"Latham on C3I," C3I Handbook, 1st ed., by the eds. of Defense Electronics (Palo Alto, CA: EW Communications, Inc., 1986), p. 26.

15DeLauer, op. cit., p. 8.

16Ibid., p. 9.

3. 17Joint Logistics Commanders, Guidance, op. cit., p.
- 18Colonel Alan D. Campen, USAF (Ret), "Government and Military Data," Signal 43.6 (February 1989), p. 81.
- 19General John A. Wickham, Jr., USA (Ret), "AFCEA's New Source Book," Signal 43.6 (February 1989), p. 17.
- 20Campen, op. cit.
- 21Management of C3 in DOD, Command and Control Course Material (Washington, DC: National Defense University, 1986).
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31R. L. Goodbody, C3I System Engineering and Integration Concepts, Technical Document 538 (San Diego, CA: Naval Ocean Systems Center, 1982).

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Joint C2 systems provide the NCA [National Command Authorities] and the commanders of the unified and specified commands with the ability to conduct joint and combined operations. In addition to joint C2 systems, command, control, and communications systems and equipment with joint implications are those that:

- a. Are intended to provide NCA connectivity.
- b. Have been designated by the Joint Chiefs of Staff or higher authority as systems/equipment having cross-Service, cross-command, cross-program, or international implications or that are of special interest. This includes prioritizations by a commander of a unified or specified command.

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CHAPTER 2

MAJOR STUDIES

Introduction

This chapter reviews the major DOD studies pertinent to command and control systems management and to joint acquisition program management.

Command and Control Systems Management

The first significant impetus in the development of the concept of an evolutionary acquisition strategy for command and control systems began in 1978 with the Defense Science Board (DSB) Task Force on Command and Control Systems Management. The DSB Task Force looked at the problem of acquiring command and control systems and stated:

The nation is failing to deploy command and control systems commensurate with the nature of likely future warfare, with modern weapons systems, or with our available technological or industrial base (1).

The Defense Science Board (DSB) Task Force found that one reason for that failure is because command and control systems have a number of characteristics that distinguish them from other types of systems developed and procured by the DOD. The DSB Task Force determined that those characteristics can be categorized as technical, managerial, organizational, and conceptual (2). The task force went on to conclude that the command and control

system acquisition process needs to reflect the special characteristics of those systems:

Most importantly, it [the command and control system acquisition process] must recognize that command and control systems must be designed from the outset to facilitate future evolution and that most systems developments will, in fact, be evolutionary adaptations of existing systems. Unlike weapon system development where change is usually highly discrete. It also must assure that the user's contribution is present from the very beginning of system design through acquisition and deployment (3).

The concept of an acquisition strategy tailored to a particular system was not new, just not very common. In fact, the Office of Management and Budget (OMB) established a government-wide policy for such strategies when the OMB issued its Circular A-109 in 1976 (4). Since then, DOD transmitted this policy down through DOD Directive 5000.1 and DOD Instruction 5000.2, into military service regulations, and by the mid-1980s, into guidance for the field (5).

Four years after the 1978 Defense Science Board Task Force report, under the auspices of the Office of the Under Secretary of Defense for Research and Engineering, the Armed Forces Communications and Electronics Association (AFCEA) looked, in particular, at the role of evolutionary acquisition in the DOD's acquisition of command and control systems. The AFCEA study team determined that evolutionary acquisition, the "build a little, test a little" approach, should be used because evolutionary acquisition creates a

much higher probability for useful improvements in command and control capability (6).

At the start of the Armed Forces Communications and Electronics Association study, all the team members shared a common experience:

Ever since DoD first attempted to automate its C2 functions with the SAGE [Semi-Automatic Ground Environment] Continental Air Defense System in the 1950s, automated C2 capability regularly was costing far more than intended, was entering the inventory far later than expected (if at all), and too often was a disappointment to real users with real needs (7).

The fault, according to the Armed Forces Communications and Electronics Association (AFCEA) study team, lay with the inherent nature of command and control systems and the traditional way of acquiring them. The AFCEA study team found the fault due to these kinds of problems:

- The uniqueness of command and control systems.
- The system for procurement and support,
- The configuration control of software.
- The meaning of architecture,
- The design for change,
- The many participants' roles and cultures,
- The business-as-usual attitude.
- The impact of joint and multinational users,
 - The degree of prior user experience with automated data processing,
 - The tradeoff between mission needs verses system solutions.
- The general failure of command and control systems programs acquired in the traditional way, and
- The inability to apply lessons learned, like including users, following an architecture, using test beds, or addressing interoperability (8).

The solution was evolutionary acquisition. But despite existing as DOD policy in 1982 (when the Armed Forces Communications and Electronics Association performed its study), evolutionary acquisition, as a strategy for use in acquiring command and control systems, was spotty and neither well defined nor well understood (9).

The problems, found by the Armed Forces Communications and Electronics Association (AFCEA) study team, echoed in more detail the conclusions of the 1978 Defense Science Board (DSB) Task Force on Command and Control Systems Management. Of the DSB Task Force's five major recommendations, one stated that the procurement and acquisition regulations needed to be modified to recognize the unique nature of command and control systems (10). DOD responded through two policies: (i) DOD Instruction 5000.2, 19 March 1980, incorporated the concept of evolutionary acquisition; and (ii) the Under Secretary of Defense for Research and Engineering promulgated on 22 March 1983 a set of acquisition principles (one of which addressed evolutionary acquisition) (11,12,13). But by late 1985, just as the AFCEA study team found in 1982, these principles still remained unimplemented (14).

The principal reason was that there were, for example, several problems which inhibit the use of an evolutionary acquisition strategy for acquiring command and control systems. In the May, 1983, issue of Signal, Dr.

Norman Waks (in 1983, the Chief Management Scientist of MITRE Corporation) listed several of these problems which serve as "Inherent Conflicts" to the use of an evolutionary acquisition strategy. These inherent conflicts represented why the acquisition community at large did not adopt such a strategy. These conflicts involved questions on how to introduce new technology, increase user influence, define command and control systems requirements, compete for funding, work the requirements process, manage system integration, allow commander flexibility, implement special management procedures, and adjust to alternative acquisition strategies (15).

In March, 1987, the Joint Logistics Commanders published policy guidance endorsing the possible use of an evolutionary acquisition strategy in the acquisition of command and control systems (16). This policy established a number of key areas (reflecting the software dominance of command and control systems) requiring special consideration when using evolutionary acquisition:

- Relationships between the acquisition executive, the user, the surrogate user, the supporter, the independent tester, and the developer, in particular with respect to:
 - System operational capabilities,
 - Operational test and evaluation,
 - Test and evaluation planning,
 - Developer-user-supporter interaction, and
 - Program review and approval;
- Program management;
- Competition in contracting;
- Control and stability of the development process;
- Configuration management, and documentation of system design;
- Production and installation;

- Software maintenance and control;
- User designed/maintained software;
- Product assurance; and
- Integrated logistic support (17).

Shortly thereafter, a second Defense Science Board (DSB) Task Force on Command and Control Systems Management issued its report (in July 1987) and concluded, somewhat like nine years earlier, "that a gap exists between the command and control systems we should be fielding and those we are fielding." (18) And again, this second DSB Task Force recommended new directives governing the acquisition of command and control systems:

These directives should recognize that the various stages of the development of command and control systems overlap; recognize that user participation in the conception, evolution, testing, and development of command and control systems is a strong requirement; and provide flexibility and adaptability to meet the wide variations in the needs of commands (19).

Despite a reasonable period of time since the formal recognition by DOD of the unique nature of command and control systems acquisition, the 1987 Defense Science Board (DSB) Task Force found that the acquisition process did not follow the guidelines in Defense Acquisition Circular #76-43 (20,21). In addition, with respect to the Joint Logistics Commanders guidance issued in March 1987 (just a few months prior to the 1987 DSB Task Force report), the task force report further stated, "Effort will be required to assist the user in implementing this guidance." (22)

Joint Acquisition Program Management

Against the background of evolutionary acquisition of command and control systems, several other trends have far-reaching effects on acquisition in general. One in particular is the increase in joint programs. For example, in the decade ending in 1984, statistics show joint programs increasing from 20 percent of major programs to 25 percent of major programs (23). Reasons for this growth range from the demand for more joint warfighting, to the need to save money, to the concern that new technology breaks traditional service boundaries (24). There are three fundamental trends which increase pressure for joint service development and procurement programs: (i) doctrinal emphasis on joint warfighting and interoperability of forces; (ii) deployment of emerging technologies permitting integration of multiservice command and control systems and force structures; and (iii) Congressional demands for greater cost-effectiveness in military procurement (25).

The years 1983 and 1984 saw three major studies on joint acquisition programs. The first by the US General Accounting Office looked at 15 joint programs, concluded that there had been no joint acquisition successes, and recommended that specific criteria be developed for use in selecting joint programs (26). The second by the Defense Science Board (DSB) looked at 64 joint programs; disagreed with the US General Accounting Office and concluded that

there have been many successful joint programs; found that problems in joint programs are most often traced to a failure of the services to agree on requirements; and recommended, among others, that the Secretary of Defense promulgate a new 5000 series directive to institutionalize the joint service acquisition process (27). In conjunction with the DSB effort, the third, called the Joint Service Acquisition Program Management Study Ad Hoc Group under the auspices of the Joint Logistics Commanders, conducted a study to supplement the DSB effort and collected quantitative data which the DSB could not collect due to time and resource constraints. The group members looked at 80 joint programs and three almost joint programs (28).

They examined joint acquisition program requirements, business practices, management, technical management, logistics and supportability, test and evaluation, and personnel. They used program success measurements based upon such factors as technical requirements compromise, degree of commonality, harmony, cost and schedule growth, and attainment of performance and supportability goals (29). From their study, the two most dominant objectives for selecting joint programs were cost savings and cross-service interoperability for systems such as communications and intelligence which serve multiple services (30). The group concluded that the services have not made the necessary commitments to execute joint programs

well and offered a number of recommendations to improve the selection, initiation, and execution of joint programs (31).

A second trend impacting on acquisition in general is new legislation. Within the past three years, legislation creating the Under Secretary of Defense for Acquisition (Public Law 99-348) and reorganizing the Department of Defense (Public Law 99-433) clearly emphasizes the preeminent acquisition-related responsibilities of designated Presidential appointees within the Office of the Secretary of Defense and the Military Departments (Army, Navy, and Air Force) (32). Additionally, the Goldwater-Nichols Department of Defense Reorganization Act of 1986 (Public Law 99-433) charges the Chairman of the Joint Chiefs of Staff with "assessing military requirements for defense acquisition programs." (33) With a more diffuse effect, legislation from the past decade also affects each of the areas requiring special consideration when using an evolutionary acquisition approach (like the 1984 Competition in Contracting Act).

Finally, the Joint Logistics Commanders' Guide for the Management of Joint Service Programs, a handbook for managers entering the world of multiservice systems acquisition, serves as a reference document to aid the understanding of the nature of joint acquisition programs. In particular, this guide covers those program management aspects which require greater emphasis than in a single

service program (34). Despite pre-publication availability, the most recent edition of the guide (September 1987) does not list the Joint Logistics Commanders Guidance for the Use of an Evolutionary Acquisition (EA) Strategy in Acquiring Command and Control (C2) Systems (March 1987) in the guide's table on "Acquisition Program Management Guidance." That table lists three documents from the Air Force, one from the Army, two from the Navy, one from the Marine Corps, and eleven from the Defense Systems Management College -- the publisher of both the "guide" and the "guidance." (35,36)

Summary

In chapter one evolutionary acquisition emerges as a rational attempt to come to grips with the nature of command and control systems acquisition. This chapter shows that, since 1976, such a strategy is consistent with existing DOD policy, which first formally embraced evolutionary acquisition in 1980. Nevertheless, because evolutionary acquisition requires a number of modifications to the normal practices of systems acquisition, the result is that, as an acquisition strategy, evolutionary acquisition is neither well understood nor widely used. It is, in fact, so unknown to joint acquisition programs that the basic guide omits any mention of evolutionary acquisition. Just as evolutionary acquisition requires a number of modifications to the normal practices of systems acquisition, joint acquisition programs, too, require a number of modifications to the

normal (single service) procedures in systems acquisition. In particular, joint acquisition programs require a "commitment" from all participating services. Chapter three looks in some detail at the uniqueness of that "commitment" both from the standpoint of an evolutionary acquisition strategy and from the standpoint of a joint acquisition program.

CHAPTER 2 -- ENDNOTES

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28Joint Logistics Commanders, Joint Program Study, op. cit., pp. ES-2, 2-5.

29Ibid., pp. 2-11, 2-16.

30Ibid., p. 3-11.

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CHAPTER 3

BASIS FOR
EVOLUTIONARY ACQUISITION
AND
JOINT ACQUISITION

Introduction

Problems in command and control systems acquisition are not new. Since the early 1960s, few participants in the process remain satisfied with the results of efforts to field, within a reasonable period of time, operationally effective systems. The principal reasons for the poor record of command and control systems acquisition stem: (i) from the lack of ability on the part of the operational command to state system needs consistent with the rapidly evolving potential provided by the computer explosion; and (ii) from unforeseen weaknesses in the classic weapon system acquisition process when it was applied to command and control systems acquisition (1).

A solution to address the reasons for the poor record of command and control systems acquisition, evolutionary acquisition is an alternative strategy for acquiring command and control systems. The most extensive

guidance on evolutionary acquisition is that promulgated by the Joint Logistics Commanders in March, 1987 (2).

The fact is that many of those command and control systems emanate from joint acquisition programs. Theoretically, a joint acquisition program saves the expense of developing separate systems and promotes the interoperability of equipment. Currently, there are about 150 joint programs and many are command and control systems programs (3).

Because of technology, operational considerations, and budget constraints, there is a great emphasis on joint acquisition programs for command and control systems programs (4). The joint force development process, established in 1984 between the Army and the Air Force, is but one example (5).

There are, however, problems with joint acquisition programs. Nevertheless, Mr Donald C. Latham (in 1984, the Deputy Under Secretary of Defense (C3I)) poses rhetorically:

With such evident dysfunctions in joint acquisitions, one may logically ask, why have joint C3I programs at all? That logical question has an equally obvious answer -- we have them because we simply do not operate or fight as a single service anymore -- a fact of life many still find difficult to swallow. Also, interoperability and cost effectiveness demand that we combine resources and system requirements in joint acquisitions (6).

The intent of this chapter is not to look at the problems per se (chapter four does that), but to look in some detail at the uniqueness of the bureaucratic

"commitment" criteria necessary to make an evolutionary acquisition strategy work and to make a joint acquisition program work. This chapter provides a brief overview of the elements of an acquisition strategy; discusses the specific acquisition strategy of evolutionary acquisition; introduces the criterion of the Packard Commission; provides an overview of joint acquisition; and, finally, offers a summary. The criteria presented here, with additional ones presented in chapter four, form the basis for chapter five's conclusions as to the suitability of using an evolutionary acquisition strategy in joint acquisition programs for command and control systems.

Elements of an Acquisition Strategy

The elements of an acquisition strategy form the basis of the acquisition process. This process performs well. When looking at acquisition programs over time, from the 1960s to the 1970s to the 1980s, DOD programs improve (or become progressively more effective at reducing certain negative trends) whether the measure is cost growth, schedule slippage, or performance shortfalls -- even when compared to civil programs similar in complexity (7.8).

For command and control systems acquisition, this process culminates in the Defense Acquisition Board and its C3I Committee (9). But the Military Departments handle the day-to-day activities through their departmental acquisition structure, to include direct support of the development and

acquisition of the command and control systems of the headquarters of the unified and specified commands (10).

The purpose of the acquisition strategy is to provide the conceptual basis for the overall plan that the program manager follows in the execution of the acquisition program (11). Tailored to each program and refined throughout the acquisition process, the acquisition strategy typically includes a number of elements:

- Use of the contracting process as an important tool in the acquisition program.
- Scheduling of essential elements of the acquisition process.
- Demonstration, test, and evaluation criteria.
- Content of solicitations for proposals.
- Decisions on whom to solicit.
- Methods for obtaining and sustaining competition.
- Guidelines for the evaluation and acceptance or rejection of proposals.
- Goals for design-to-cost.
- Methods for projecting life cycle costs.
- Use of data rights.
- Use of warranties.
- Methods for analyzing and evaluating contractor and Government risks.
- Need for developing contractor incentives.
- Selection of the type of contract best suited for each stage in the acquisition process, and
- Administration of contracts (12).

An acquisition strategy, then, defines the relationships between the various aspects of the program. Although each service addresses an acquisition strategy in slightly different ways, all services' acquisition strategies (or in some cases, plans) tie together -- over time -- management, technical, business, resource, force

structure, support, testing, and various other aspects of the program (13).

Evolutionary Acquisition

Evolutionary acquisition is an acquisition strategy to provide an early, useful capability even though detailed overall system requirements cannot be fully defined at the program's inception. To reduce what can be very great risks involved in system acquisition, program managers and users develop and test the system in manageable increments. Command and control systems are likely candidates for evolutionary acquisition because their system requirements are difficult to quantify or to express and are expected to change due to scenario, mission, theater, threat, or emerging technology (14). According to Brigadier General Edward Hirsch, USA (Ret) (in 1985, Professor of Systems Acquisition Management at the Defense Systems Management College), an evolutionary acquisition strategy requires:

- A general functional description of the total overall capability desired;
- A short requirements statement;
- A flexible architecture permitting accomplishment of evolutionary change with minimum redesign;
- A plan for evolution that leads toward the desired capability;
- Early fielding of an initial basic (core) operational capability;
- Subsequent increments of capability defined, funded, developed and fielded; and
- Provisions for utilizing continuous user, developer and tester feedback (15).

The above seven requirements address just one primary measure of an acquisition strategy -- performance. The other two primary measures -- cost and schedule -- address the bottom line. There are several unique aspects of an evolutionary acquisition strategy, and they influence those three primary measures of an acquisition strategy.

For better program and system performance, those seven requirements above succinctly delineate how to implement an evolutionary acquisition strategy for command and control systems. While some of the seven remain self-evident, two of them (functional description and architecture) are unique to command and control systems; and one of them is unique to evolutionary acquisition (continuous user, developer, and tester feedback).

Functional Description. As an example, the Command Center Improvement Program proposes that the community of the Worldwide Military Command and Control System -- in particular, the unified and specified commands -- has nine basic functions: (i) situation monitoring; (ii) situation assessment; (iii) decision-making and support; (iv) force and resource status monitoring; (v) operations planning and scheduling; (vi) force employment monitoring; (vii) order and mission instructions; (viii) employment and execution of forces (initial & reconstituted), and (ix) hostilities termination (16).

The relative importance of those nine basic functions differs from command to command. Because of the unique and critical significance of its warning and surveillance mission, the United States Space Command (a unified command), for example, consolidates those nine basic functions into five broad categories to emphasize situation monitoring and assessment more than force employment (17).

Architecture. A command and control system architecture is the arrangement of the basic elements into an orderly system framework that describes the interrelationships between selected elements of the system (18). The Armed Forces Communications and Electronics Association study team writes that command and control systems architectures can be viewed from two major perspectives:

(1) from an operational or mission view and (2) from a systems or technical view. The operational or mission view is concerned with what the C2 system must do to support a given military mission(s) and how information, decisions, and tasks which are collected, made, and performed relate to force deployment and employment, given a set of threat environments. The systems or technical view is concerned with how (and how well) the C2 system collects, analyzes, transmits, and displays appropriate information in a timely, reliable, and understandable manner. C2 systems exist and must respond to change in each of these dimensions. Hence, two architectures are required to co-exist: (1) a theater/mission architecture to define the operational context and functional (military) requirements (how they may change) and (2) a system architecture that defines system capabilities (technical characteristics and performance) and interfaces (19).

Examples of each perspective on architecture are common. The Army command and control system architecture orients on the theater (20). Whereas, the United States Space Command's command and control system architecture orients on systems through its Integrated Tactical Warning/Attack Assessment Architecture (21). Finally, the Joint Tactical Command, Control, and Communications Agency's concept of a command, control, and communications architecture orients on both -- mission areas and supporting technologies -- and adds procedural standards (22).

Continuous User, Developer, and Tester Feedback. While each requirement above for evolutionary acquisition is important, the last one is key -- continuous user, developer, and tester feedback. These relationships must be given special consideration. In conjunction with the independent test and evaluation agency, the user determines the readiness for operational use of the core system and works closely with the developer in evaluating subsequent increments of new technology (23).

Normally in systems acquisition, a higher headquarters frequently specifies operational requirements for the system, while the real user may be rather far removed from this process. On the other hand, in using evolutionary acquisition to acquire command and control systems, the real user has a major voice in formulating operational requirements and in defining detailed system

characteristics (24). The intent is that the real users are the fighting formations provided by the services to operate under the multiservice command; the user is not the service per se (25).

For the developer, an evolutionary acquisition strategy addresses a fundamental problem in command and control systems programs -- the hardware and software technologies change at a much faster rate than the traditional acquisition program. Evolutionary acquisition assists the developer in four ways, by: (i) keying procedural model development to evolving doctrine and technology, (ii) supporting functional interface development, (iii) easing automation's structural impact from the functional life cycle of the system (26), and (iv) providing a basis to address software complexity (27).

Because evolutionary acquisition inherently complicates testing, the use of test beds plays a critical role the execution of an evolutionary acquisition strategy (28). Test beds provide the means to investigate numerous complex design concepts through both software and hardware and provide the time to implement any significant design decisions during the development process (29). The Strategic Defense Initiative Organization, for example, has a National Test Bed dedicated to the Strategic Defense Initiative for addressing the many critical issues

associated with command and control systems in support of an eventual Strategic Defense System (30).

The Bottom Line. By using an evolutionary acquisition strategy for command and control systems, there exists potential cost and schedule savings (the remaining two primary measures of an acquisition strategy), which serve to induce program managers to consider using such a strategy. In 1981, one writer concludes early on that an evolutionary acquisition strategy could reduce acquisition costs by 24 percent and shorten development times by one to three years (chiefly through eliminating full scale development and combining concept exploration/definition with concept demonstration/validation) (31). Such programmatic good fortune, coincidentally, also reflects what Lieutenant General Emmett Paige, Jr. (in 1986, Commanding General, US Army Information Systems Command), describes as

an accommodation of the real world situation where we cannot afford to buy a complete C3I system at one time, and where we need to consider the rate of technological change as we field C3I systems over the life of several equipment generations (32).

But such programmatic good fortune remains elusive. Over the past thirty years, only one class of automated command and control systems remains successful -- air defense systems, acquired not under an evolutionary approach, but under a traditional "turnkey" approach (33). (The "turnkey" approach means the first user involvement is

at the delivery of the complete system (as for example with a car, where the first user involvement with the product is at the key turn at delivery).) The most likely reason is because these systems have fundamental characteristics like well-defined functions, network connectivity, and man-machine interfaces. Otherwise, without those well-defined fundamental characteristics, another writer concludes that evolutionary acquisition's major benefit is to provide hard evidence of the deficiencies before expending large amounts of time and money (34).

Evolutionary Acquisition Criteria. The Armed Forces Communications and Electronics Association's Command & Control (C2) Systems Acquisition Study Final Report establishes a number of criteria stipulating when command and control systems shall be acquired in an evolutionary manner. These criteria are:

- The requirements are not definite.
- The user is not satisfied with the completeness of the requirements specification.
- Requirement changes are expected to be rapid or extensive during the useful life of the system.
- The user can not specify acceptance (quantitative operational utility) criteria for the system which others can be expected to apply objectively to measure operational mission performance.
- The user's role can not be minor during development.
- There is not an insignificant amount (relative to total program size) of man/machine interfaces and new software development involved in the program, the latter of a type which is highly interactive with the decision process (35).

Packard Commission Criterion

The President's Blue Ribbon Commission on Defense Management (June 1986) -- the Packard Commission -- reveals that there are certain characteristics common to successful government projects (and to successful commercial projects as well) (36). In particular, an evolutionary acquisition strategy's emphasis on building and testing prototype systems, on beginning operational testing early, and on communicating with users represents a collection of features which the Packard Commission found typical of the most successful commercial programs (37). So, in comparing the Packard Commission's recommendations relative to an acquisition strategy, evolutionary acquisition of command and control systems supports, to some extent, those recommendations.

But there the similarity stops; for the Packard Commission's fundamental criterion for success in program acquisition, including command and control systems acquisition, is "An informed trade-off between user requirements, on the one hand, and schedule and cost, on the other." (38) The Packard Commission indicates that this informed trade-off is achieved through a balance of cost and performance:

A delicate balance is required in formulating system specifications that allow for a real advance in military capability but avoid goldplating. Generally, users do not have sufficient technical knowledge and program experience, and acquisition teams do not have sufficient experience with or

insight into operational problems, to strike this critical balance. It requires a blend of diverse backgrounds and perspectives that, because the pressures for goldplating can be so great, must be achieved at a very high level in DoD (39).

Quite clearly, the criteria for an evolutionary acquisition strategy do not focus on the informed trade-off important to the Packard Commission, but on an informed trade-off between requirements. Joint acquisition programs compare differently relative to the Packard Commission's criterion -- an informed trade-off between user requirements, on the one hand, and schedule and cost, on the other.

Joint Acquisition

Pros and Cons. Although there are many reasons for joint acquisition programs, most reasons point to some operational or economic advantage to DOD. Usually, several factors exist: (i) coordination of efforts; (ii) interoperability of equipment; (iii) reduction in costs; (iv) reduction in logistics requirements; (v) commonality of requirements; (vi) increase in military effectiveness; (vii) exploitation of technology; and (viii) credibility to the Congress and to the public (40,41,42).

Despite what seem like valid reasons for embarking on a joint acquisition program, there exists much resistance to such an approach (43). When joint systems are deployed, DOD appears to get little commonality or interoperability of

equipment and little evidence to support the fiscal benefits of joint acquisition (44,45,46).

Yet, according to the Defense Science Board 1983 summer study on joint service acquisition, about two-thirds of the joint acquisition programs are "successes" or have good prospects for success. Relative to command and control systems, however, as long as the critically-important abilities to interoperate and intercommunicate are preserved, a program need not be joint to be successful (47).

Consequently, in order to obtain operational or economic advantage, joint acquisition programs need to insure that the technical, organizational, and funding bases exist between the participating services and agencies and that the operational and technical requirements issues are resolved at the beginning (48,49). That is not easy, because executing joint acquisition programs requires an understanding of each service's doctrine and acquisition (50). Joint acquisition programs are very, very difficult to execute and administer (51).

Procedures. Currently, DOD's formal procedures for selecting joint acquisition programs center on the Vice Chairman of the Joint Chiefs of Staff (VCJCS), whose position the Goldwater-Nichols Department of Defense Reorganization Act of 1986 created (52). The VCJCS's responsibilities include chairing the Joint Requirements

Oversight Council; vice chairing the Defense Acquisition Board; and representing the Chairman of the Joint Chiefs of Staff on planning, programming, and budgeting system matters in deliberations of the Defense Resources Board (53).

The Joint Requirements Oversight Council has two mechanisms, one dealing with development activities and the other one with requirements definition. For the former mechanism, the Joint Potential Designation List -- an annual process -- classifies acquisition programs as: (i) joint, where a potential for joint program management and/or joint procurement exists, or (ii) interoperating, where joint program management is inappropriate, but a potential for joint operation or joint system interface exists, or (iii) independent, where no potential for other service use or joint systems development exists. For the latter mechanism, the concept under consideration mirrors the Army's Concept Based Requirements System (54,55,56).

The Joint Requirements Oversight Council endorses a concept on a preferred funding arrangement for joint programs in which programs falling under this concept must have a firm statement of requirements and a detailed agreement covering technical baselines (57). The Joint Service Acquisition Program Management Study Ad Hoc Group also calls attention to the necessity to define the Joint Statement of Operational Requirement and to agree between the participants on roles and schedules to provide stability

to the program (58). Without program stability, the consequence is compromised users, restricted technology, and escalated costs (59).

To prevent those unanticipated consequences, the Joint Service Acquisition Program Management Study Ad Hoc Group recommends creating a program baseline to maintain program stability. The objectives of such a baseline are to formalize management commitment, discourage changes, reduce requirements creep, provide a disciplined mechanism for cost control, establish a basis for performance measurement, and require strict change control procedures (60). DOD Directive 5000.45, Baselining of Selected Major Systems, now provides for the baselining of selected major systems and for the changing of an established baseline only under extreme circumstances, such as a significant change in threat, budget, test results, or Congressional action (61).

Joint Acquisition Criteria. The Joint Service Acquisition Program Management Study Ad Hoc Group's Joint Program Study Final Report establishes a number of criteria stipulating when an acquisition program shall be acquired as a joint acquisition program. These criteria are:

- Is the end item clearly single service?
- Net cost benefit? and/or
- Joint warfighting/interoperability benefit?
- Can the requirements be resolved?
- Is there a basis for commitment? (62)

Despite guidance from the Joint Logistics Commanders that nothing is more important to the success of a joint

program than inter-service agreement on requirements and funding (commitment) (63), the services quite often disagree. Consequently, the need to pin down requirements and funding to execute joint programs seems at cross purposes with an evolutionary acquisition strategy in which the full capability does not occur when initially deployed, but occurs in increments over time.

Summary

Both an evolutionary acquisition strategy and a joint acquisition program have unique modifications to the normal practices of systems acquisition. Do those unique modifications require bureaucratic "commitments" which are incompatible?

As stated earlier, there is one fundamental criterion, the Packard Commission's, for success in program acquisition -- an informed trade-off between user requirements, on the one hand, and schedule and cost, on the other. This criterion provides the basis to decide if to apply an evolutionary acquisition strategy in a joint acquisition program. This criterion also neatly sums up the difficulties in deciding what guidance program managers should follow when considering using an evolutionary acquisition strategy in joint acquisition programs.

Even given that evolutionary acquisition is oriented on only those few characteristics that distinguish command and control systems, the Packard Commission's criterion

clearly emphasizes the importance of cost and schedule regardless of the type of system. In contrast, the discussion above on evolutionary acquisition significantly reflects the role of requirements. What becomes quite obvious in discussing the bottom line of cost and schedule is the relatively little information available on that point (with respect to use of an evolutionary acquisition strategy) considering the importance of cost and schedule as established by the Packard Commission.

The criteria for joint acquisition programs, on the other hand, remain relatively consistent with the criterion established by the Packard Commission. The criteria for joint acquisition programs, however, remain somewhat inconsistent with analogous criteria for evolutionary acquisition. In fact, the only real overlap is in requirements; but with respect to that overlap, there is a disconnect between the two criteria. For joint acquisition programs to be successful, requirements must be resolved; for use of an evolutionary acquisition strategy, requirements are not definite -- therefore, they are not resolved.

A question remains: Is this a sufficient basis to determine the suitability of using an evolutionary acquisition strategy in joint acquisition programs for command and control systems? To see if other criteria emerge, chapter four, using nine "inherent conflicts" in

evolutionary acquisition, examines whether they, too, serve as additional criteria, or simply reinforce the criterion established by the Packard Commission.

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functional model, an internetted web, whose eight critical
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sustainment, (vii) development, and (viii) separation. Each
individual resource (a person or thing) will move through
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1986. The preferred funding arrangement concept for joint program funding is:

- The lead service, particularly on major programs, should have total program funding authority and responsibility. Funding arrangements should be agreed to as early in the acquisition process as possible.

- Each participating Service should fund its own:

- Service unique integration efforts
- Service unique improvements/changes
- Service procurement

- Programs falling under this concept must have;

- A firm statement of requirements
- A commitment to funding (R&D and

procurement)

- A detailed MOA/MOU covering funding, management, and technical baselines.

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CHAPTER 4

CONFLICTS IN USING AN EVOLUTIONARY ACQUISITION STRATEGY IN JOINT ACQUISITION PROGRAMS FOR COMMAND AND CONTROL SYSTEMS

Introduction

In the May, 1983, issue of Signal, Lieutenant General Robert Herres (in 1983, Director, Command, Control, and Communications Systems Directorate, Organization of the Joint Chiefs of Staff; now, the current JCS Vice Chairman) states,

I have since found that the problem with the evolutionary acquisition concept is that the term is easy to use, but it is hard to implement. What are we going to do, or have we done, to the acquisition process to accommodate that, i.e., to the rules that guide the day to day realities of program management? The point is that there has been more talk about the evolutionary approach, which I enthusiastically support, than there has been about what one does with the various directives and procurement regulations (1).

Ironically, the only attempt to date to focus on what Lt Gen Herres calls "the day to day realities of program management" occurs in the same Signal issue. In another article in that issue, Dr. Norman Waks (in 1983, the Chief Management Scientist of MITRE Corporation) addresses some of the outstanding issues not covered in the Armed

Forces Communications and Electronics Association (AFCEA) study team's 1982 Command & Control (C2) Systems Acquisition Study Final Report (2,3). He supplements the AFCEA report by describing briefly some of the more basic conflicts inherent in using an evolutionary acquisition strategy for command and control systems acquisition. He lists these several conflicts as inhibitors to program success:

- Introducing new technology,
- Increasing user influence,
- Defining system requirements,
- Competing funding interests,
- Developing appropriate requirements,
- Managing system integration,
- Allowing commander flexibility,
- Implementing special management procedures, and
- Using alternative acquisition strategies (4).

Because these conflicts represent outstanding issues regarding evolutionary acquisition and the acquisition process, they serve as a source for criteria upon which to judge the use of such an evolutionary acquisition strategy in a joint acquisition program -- not in an absolute, certain sense, since the day to day rules do not exist; but in a relative, suitable sense, since someday whatever directives and regulations that do implement evolutionary acquisition must account for these issues. This chapter looks at each of those inherent conflicts to determine their relevance as criteria to concluding whether an evolutionary acquisition strategy for command and control systems is appropriate in joint acquisition programs.

New Technology

According to Dr. Waks, introducing new technology causes the user to ask, why do I need anything new (evolved from today's system) when what I have adequately does the job? What contribution is made to my job when materiel is user "unfriendly"? What is the point when these systems cannot be rugged enough for field use (as in the use of nondevelopmental items)? (5) Consequently, while evolutionary acquisition may be a satisfactory method for the developer to obtain new technology, evolutionary acquisition may inspire less than an enthusiastic response from the user; for the user must in parallel develop new ways of doing things with that technology (6).

But introducing new technology in an evolutionary manner has risks for the developer too. For example, the Defense Science Board 1985 summer study on practical functional performance requirements supports use of block upgrades, somewhat akin to evolutionary acquisition (7). Similarly, the Defense Science Board 1983 summer study on joint service acquisition programs endorses a series of evolutionary, "learn-by-doing", technology demonstrations, with strong user involvement (8).

Despite the apparent recognition of the value of an evolutionary approach, both Defense Science Board reports find otherwise. The 1985 Defense Science Board summer study finds that successful programs either have the required

technologies in hand before development or have the relevant risks identified, recognized, and programmed through schedule and resources (people, money, things, information) (9). This is not typical in an evolutionary acquisition approach.

Similarly, while there have been many successful joint programs, the 1983 Defense Science Board summer study concludes that most successes occur in non-major systems, subsystems, components, and technology base programs (10). These kinds of successful joint programs are not the kinds of programs common in command and control systems acquisition.

User Influence

Dr. Waks proposes that increasing user influence has a downside for the user: where am I -- the user -- going to get the money, the people, and the types of talent I need to "influence" the evolution of these systems? (11)

This is an organizational problem of concern when using an evolutionary acquisition strategy, since prior user experience with automatic data processing impacts on the development effort, in particular for joint users. Joint users, too, have a cognitive limit and require some degree of sophistication and understanding in order to identify valid needs and uses for command and control systems (12). But joint users tend not to have the sophistication and understanding of their unique systems compared to their

counterparts in the services. The result is that the military departments, serving as the acquisition executives, focus their attention and funds on their own command and control needs (13).

When the users happen to be the unified commands, there are three other areas of specific concern regarding experience when they have more participation in command and control system management. The first is configuration management and life cycle support responsibilities -- do they have the funds necessary to effectively fulfill their responsibilities in those areas? The second is technical personnel -- is the use of a cadre of systems engineering personnel appropriate for an operational command? The third is duplication of effort -- if the systems engineering efforts of the unified commands are not coordinated with the service acquisition commands, will there be needless duplication of effort? (14) Indeed, the 1985 Defense Science Board summer study on practical functional performance requirements singles out the unified commands'

dely varying responsibilities, missions, and staffing as contributing to acquisition problems characterized by inadequate resources, overstated performance goals, and concealed risks (15).

On the other hand, for users who are not joint, but the program is for compatibility and interoperability (in particular, for tactical command, control, communications,

and intelligence systems (16)), Dr. James Wade (in 1985, the Assistant Secretary of Defense for Acquisition and Logistics) reports the individuals, serving as the "joint" users, seem to focus their attention and time on interservice rivalries that hinder joint planning and acquisition, as well as hinder the optimal use of new technology (17).

Command and Control System Requirements

Defining system requirements offers some frustration to the developer according to Dr. Waks: how can life cycle costs be accommodated with sound programmatic decisions since in this "core" dependent approach, requirements are so difficult to describe? (18) Indeed, an evolutionary acquisition strategy needs complete information to evaluate the current increment, as well as to identify, concurrently, areas where additional improvement is required (19).

But influential policy makers believe there is a definite boundary between when to evolve requirements verses when to "stay put." In the event of technological opportunities, the Defense Science Board 1985 summer study on practical functional performance requirements recommends block upgrades to incorporate deferred requirements introduced during development and thereby to preserve the schedule (20). Similarly, in the opinion of General Lawrence A. Skantze (in 1985, the Commander, Air Force Systems Command):

Our dilemma starts with the fact that technologies evolve faster than the acquisition cycle of the systems they can improve. Managing requirements for C3 systems is a greater challenge than managing systems in other mission areas. That's primarily due to the large number of customers for C3 and the network to meet their needs. After we've set requirements for the proverbial Block I (increment of change), all levels of the Department of Defense and industry have to agree to corral any emerging technologies until Block II. Otherwise, we can easily reach a point where we won't be able to freeze a C3 system configuration long enough to produce and field it. In successful C3 programs, like any acquisition program, there comes a time to shoot the innovators and get on the production. It's just been harder to do in C3 programs (21).

Not only is the "when" a problem in requirements definition, but the "what" is too. To illustrate a problem common to users from unified commands, the services buy things (like hardware and software comprising radar systems and communications systems). Instead, the unified commands really need mission systems (like defending the Continental United States against air and missile attack). The services just are not sufficiently organized to meet such a requirement calling for a combination of "things," such as sensors, platforms, weapons, and command and control systems, which together fulfill the requirements of the user (22,23).

For joint acquisition programs, defining command and control systems requirements is just as difficult. As Admiral William J. Crowe, Jr. (current JCS Chairman), writes, "Perhaps the overarching challenge is best understood as one of adequately identifying requirements."

(24) Similarly, joint acquisition program requirements are "The Number One Problem" according the Comptroller General, who cites different perceptions of requirements, doctrines, and operational features, but especially doctrinal requirements (25,26). Subsequent to the Comptroller General's 1983 report, the Defense Science Board 1983 summer study on joint service acquisition programs also attributes problems in joint programs most often to the failure of the services to agree on requirements (27).

How does this impact on command and control systems acquisition? To begin, about 65 percent of DOD's command and control programs are joint acquisitions (circa 1984) (28). Many suffer from a lack of clearly defined, agreed-to requirements. The WWMCCS (Worldwide Military Command and Control System) Information System is just one example (29).

But on the other hand, requirements which satisfy everyone drive up program expenses; and the coordination process associated with joint programs just requires more time. Thus, users, who originally wanted the system, attempt to shift to service unique programs or to eliminate the requirement altogether. As Mr. Donald C. Latham (in 1984, the Deputy Under Secretary of Defense (C3I)) writes,

Part of this problem is the nature of the planning, programming and budgeting process within the Department. Each Military Department will naturally value the internal programs which satisfy its own mission requirements higher than the joint programs in which it participates. Thus when prioritization actions must be taken to reduce resource

allocations, the joint programs suffer disproportionately (30).

Competition for Funds

From the developer's perspective according to Dr. Waks, is the program repeatedly exposed to a competition for funds? (31) Because evolutionary acquisition requires participation by users and developers over a longer period of time, evolutionary acquisition has to be supported by protection of out-year funds (32). Such an acquisition strategy looks like a blank check (33).

For a number of reasons, that is not good for a joint program. First, according to the Joint Program Study Final Report, rates for average cost and schedule growth for joint programs already are significantly higher than similar rates for single service programs. The report's statistical analysis shows that the factors most closely associated with those higher rates are problems in resolving performance requirements and turbulence in funding (34).

Second, those factors increase development time and, as a result, increase vulnerability to program changes and inflation (35). Regardless of whether a program is joint or not, throughout the DOD there is a resource allocation and control problem, which service acquisition leaders and managers have identified. This problem begins at the top with a disconnect between the resource decisions made in the life cycle management process by the Defense Acquisition

Board and the subsequent resource decisions made during the Planning, Programming and Budgeting System process by the Defense Resources Board (36). For command and control systems, an evolutionary acquisition strategy consequently exposes the program to more of these systematic fluctuations; a joint acquisition program merely compounds the problem.

Third, those factors (problems in resolving performance requirements and turbulence in funding), too, serve to undermine support within the military departments which tend to consistently underfund "purple" programs that compete with their organic service needs (37). Often, as the Defense Science Board 1983 summer study on joint service acquisition programs finds, major problems accrue to the joint program when one service reduces its funding due to changing priorities, an issue that largely disappears for single-service funded joint programs (38).

Consequently, since command and control systems are relatively unglamorous, they often receive lower priority in budget allocation, especially if they are joint. Because the services' program and budget resources depend in large part on internal advocacy, joint programs, which lack that natural internal advocacy, frequently take disproportionate cuts in resource programming and budgeting. As a result, the DOD advocate for joint C3 programs becomes the Assistant Secretary of Defense for C3I (ASD(C3I)) and his staff.

Using such "high level firepower" each year in the resource allocation process causes a massive consumption of ASD(C3I) staff resources and probably a temporary disruption of the program (39).

Mr. Kelly Campbell (in 1985, former US Representative to the NATO Infrastructure Committee) illustrates what can happen when an evolutionary acquisition strategy is used for joint program acquisition (albeit in a multinational environment).

NATO C3I projects fall into essentially two groups -- new departures and replacement/upgrading. Group One projects will usually be more complex and therefore centrally-managed [for example, the NATO Integrated Communications System (NICS) or the NATO Air Command and Control System (ACCS)]. Since Group Two projects start from known technology and are less complex, they can be decentralized to individual host nations [for example, the NATO Air Defense Ground Environment (NADGE) Upgrade]. This distinction can be important because host nations do not always buy to standard specifications. . . .

. . . Complex, expensive and current, the ACCS [Air Command and Control System] gives some indications of [the impact of an acquisition strategy to a Group One project] . . . [T]he long-term design for the ACCS must marry the use of emerging technology with shorter term need and budgetary limitations. It was considered that this could best be done by following an evolutionary approach instead of the kind of "turn-key" project represented by the NADGE and other systems of that generation. . . .

. . . [But use of an evolutionary approach to acquire the ACCS, has not lead to a successful acquisition program.] It is impossible to ignore the disadvantages of the pattern we observe here, that is, careful preliminary study and preparation and an evolutionary approach to the acquisition of systems. Given rapidly escalating costs, particularly in the C3I area, this will make it more difficult to bring to fruition the longer-term

elements of the ACCS plan. The alternative obviously is to attempt to design a total system and to install it in as short a period of time as possible. This was the approach taken in Phase One of the NATO Integrated Communications System [(NICS)], and, in spite of all the problems which have been described elsewhere . . . the elements of NICS One will be substantially operational within the next two or three years. At the same time, the evolutionary idea which was embodied in NICS Phase Two has fallen by the wayside, due almost entirely to concerns about cost escalation and competing military priorities (40).

Requirements Process

The process to develop appropriate requirements affects both the user and the developer (41,42). With respect to evolutionary acquisition of command and control systems, there is the need for requirements to be as dynamic as possible so that user needs evolve on the basis of a feedback driven "design-and-try-out" philosophy; but, there is also a need for requirements to be as stable as possible so that the command and control capability needed by the user will be satisfied (43).

The most pressing problem in the command and control systems arena is the requirements process because of the goldplating tendency (from overstated requirements and specifications) and because of the systems' complexity (44). There clearly is, however, a dichotomy between attempting to stabilize requirements and allowing them to change. But, as General Lawrence A. Skantze (in 1985, the Commander, Air Force Systems Command) states, "changing requirements introduce risk. At worst, they also increase cost, stretch

the acquisition life cycle, and delay delivery of a critical weapon system." (45) In fact, the Defense Science Board 1985 summer study on practical functional performance requirements recommends that schedule be the dominant driver regardless of changes in operational requirements (46).

Nevertheless, even though an evolutionary acquisition strategy has an inherent conflict in the management of change, the change process has some degree of formal structure. Unfortunately, the joint requirements process does not; for it behaves as if there were no process at all (47).

To start, the necessary participants in the joint requirements process encompass a variety of relatively powerful and co-equal players, including the Office of the Secretary of Defense, the Organization of the Joint Chiefs of Staff, the unified commands, the services, and "technology" (industry, service laboratories, allies, etc.) (48). No "military umpire" exists in the process to settle effectively cross-service disputes such as joint service requirements (49).

Second, the JCS requirement validation process, for example, is time consuming, even though the capability being sought is clearly needed, technically feasible, and not necessarily very costly. According to Mr. Donald C. Latham (in 1987, the Assistant Secretary of Defense (Command,

Control, Communications, and Intelligence)), "this time lag is a basic flaw in the acquisition process." (50)

Third, the joint requirements process has little relation to its resourcing. Even if the requirement were validated by the Joint Chiefs of Staff, resource support is not automatic. The service or agency responsible must program and budget for the requirement in its Program Objective Memorandum. If the service or agency does not, this becomes an issue raised to the Office of the Assistant Secretary of Defense for C3I. Invariably, these issues involve joint programs and systems and fall below the threshold for high-level attention in the Defense Resources Board (51).

Integration Management

A basic problem in command and control systems programs is that the hardware and software technologies change at a much faster rate than the traditional acquisition program. Evolutionary acquisition addresses that fundamental problem in command and control systems acquisition programs in four ways by: (i) allowing development of adequate procedural models keyed to evolving doctrine and technology; (ii) supporting detailed development of interfunctional interfaces as more and more functional areas are automated and connected to one another; (iii) easing the structural impact of automation which results during the functional life cycle of the system (52);

and (iv) providing a basis to address the complexity in producing necessary software (whether program or component, embedded or mission critical, etc.) (53).

But doing that is not so easy, as Lt Gen Herres states, "the rules that guide the day to day realities of program management" are not there.

For example, there is little guidance other than a policy caution regarding continuity (54). Yet, because command and control systems are software dominated, they require a development process, not a production-like process (55). Consequently, continuity in players, in particular the development contractor, is necessary if the subsequent acquisitions under an evolutionary acquisition strategy are to be successful. Otherwise, problems affecting a smooth evolution arise due to insufficient similarity (whether in terms of design or provision for size, interfaces, etc.) between the two contractor's designs (56).

There is, as well, little guidance regarding the unique challenge faced by the tester for systems being developed under an evolutionary acquisition strategy. As the International Test and Evaluation Association states, the tester

must test the core system during fielding and the first increment before the core testing is completed. This could lead to a situation where the tester has three or four tests ongoing on various increments of the same system (57,58).

Managing system integration with an evolutionary acquisition approach involves a number of other factors which can lead to fundamental stumbling blocks in achieving operational capabilities. One is increased user influence (59). Another is lack of quality assurance if instability reigns during rapid system evolution (60). And another, more significant one, is standardization -- a problem that has festered in DOD since the 1960s (61).

In calling for more emphasis on standards and interoperability issues, Lieutenant General Emmett Paige, Jr. (in 1986, Commanding General, US Army Information Systems Command), states,

The benefits of [evolutionary acquisition] have created a greater demand on systems integration. As a community, we are just beginning to get a handle on standards that would govern the integration of the various phases of a C3I systems evolution (62).

Industry, too, focuses on standards as one way for DOD to come to grips with management of system integration problems in command and control systems acquisition. In their March, 1984, report to the Under Secretary of Defense (Research and Engineering), entitled DOD Management of Mission-Critical Computer Resources, the Council of Defense and Space Industry Associations identifies a number of command and control systems acquisition issues like high development cost and risk, high operational/logistics cost, low operational availability, poor battle survivability, etc. The Council of Defense and Space Industry Associations

indicates that solutions to these problems seem to require standardization (63,64).

Managing system integration in joint acquisition programs also has a number of factors which can lead to fundamental stumbling blocks in achieving operational capabilities. Besides legitimate, real differences in technical and operating requirements, service differences in doctrines, operations, logistics, and procedures diversify system designs (65,66). Differences in language and terminology and in test and evaluation add further challenges (67). And a complicating factor is that the services are not able to assimilate new capabilities that require the combination of "things" as in command and control systems (68).

By-and-large, there are two major problems which impact on managing system integration in the execution of a joint acquisition program. One is a lack of program stability; the other is the "plethora" of service business practices (in management, budgeting, program control, contracting, logistics, test, personnel, etc.). This "plethora" includes acquisition strategies (69).

Unfortunately, in addressing that "plethora," joint acquisition programs often fail to have adequate organizations (70). As a consequence, joint acquisition program organizations have difficulty responding effectively

to thorny issues such as in logistics (71,72). Single service programs handle such issues more responsively (73).

Because single service programs do integrate systems better, one concept for major joint command and control system integration is to allow the military departments to procure their own equipment as long as it is compatible with agreed-to standards, protocols, and performance requirements. Such an approach builds on an existing system architecture and supports an evolutionary acquisition strategy (74,75,76).

Regardless of whether the program is a joint program, a command and control system acquired with an evolutionary acquisition strategy has a sustainability problem in deployment. This is because current integrated logistics support approaches introduce fielding delays when coupled to an evolutionary development, even though such development is designed to speed fielding. In addition, rapid fielding of command and control systems is incompatible with the training cycle of the service schools (77).

Commander Flexibility

An evolutionary acquisition strategy has, according to Dr. Waks, inherent conflicts between a commander's ability to achieve uniformity for command and control systems and for their operators, and to achieve interchangeability between those same systems and those same

operators. This conflict affects the ability of commanders to obtain dedicated systems and operators, each capable of supporting the commander's mission, while at the same time, to obtain "standard" systems and operators -- systems capable of being supported by a common logistics train and operators capable of functioning in a new environment without depriving the losing command of unique system knowledge (78,79).

Because joint acquisition programs function in a bureaucracy, joint program managers, too, have problems pursuing their organizational interests through myriad bureaucratic practices, which get progressively more difficult at each higher level of management (80).

In fact, to ensure that the services cooperate with each other, the staff of the Assistant Secretary of Defense (C3I) provides detailed oversight because of the problems in joint programs and in command and control system interoperability (81). With such centralized oversight in joint programs, little latitude remains for the program manager to evolve the program's acquisition (82).

Special Management Procedures

Can the DOD acquisition system culturally absorb the changes required for command and control systems when other types of systems (like avionics), too, may require other types of special management procedures (like nondevelopmental item or pre-planned product improvement)?

(83) Or is the traditional life cycle system management model best? (84,85) A case in point here is what is known as mission critical computer resources.

The Federal Property and Administrative Services Act of 1965 (Public Law 89-306), more commonly known as the Brooks Bill, gave the General Services Administration responsibility for the purchase of automated data processing equipment by the federal government (86,87). Early on, though, DOD weapon system computer resources were exempted as a class called embedded computer resources (ECR):

The term ECR included a narrowly defined class of computer equipment, software, documentation, personnel, and facilities integral to a defense weapon system (88).

Seventeen years later, the Warner-Nunn Amendment to the DOD Authorization Act of 1982 (Section 908, Public Law 97-86) broadened the range of embedded computer resources excluded from the provisions of the Brooks Bill (89). In so doing, DOD weapon system computer resources were exempted as a broader class called mission critical computer resources (MCCR) (90): the term MCCR now includes DOD computer resources if the function, operation, or use of the equipment or services --

- Involves intelligence activities.
- Involves cryptologic activities related to national security.
- Involves the command and control of military forces,
- Involves equipment that is an integral part of a weapons system, or
- Is critical to the direct fulfillment of military or intelligence missions (91).

DOD Directive 5000.29 applies to both the earlier ECR and the current MCCR and represents one example of procedures instituted to specially manage acquisition of specific systems (92). When MCCR support command and control systems, a distinction exists between command and control systems and a number of other automated DOD materiel items also intended to control something (such as the control element of a communications system and embedded control elements of individual weapons, even though these elements have a number of the major characteristics of command and control systems). On the contrary, according to the Armed Forces Communications and Electronics Association study, Command & Control (C2) Systems Acquisition Study Final Report,

The difference is that the other systems are not involved in human control, but in physical control. In fact, their very purpose is to eliminate the human from the loop as much as possible, not further his role in it (93).

(Somewhat facetiously, joint acquisition programs also require a human in the loop -- a "godfather" to keep the program going through highly placed, vigorous DOD advocacy (94).) For quite some time then, through DOD Directive 5000.29, special management procedures apply to command and control systems. In fact, adding the adjective "joint" makes no difference.

According to a 1982 JCS approved memorandum entitled "Policy and Procedures for Management of Joint Command and

Control Systems," several factors require programs to have special management procedures, where appropriate, to minimize system duplication and to further standardization. These factors are: resource limitations; an evolving technological base; multiple requirements for interfaces; the need for compatible procedures throughout the chain of command; and the need to involve end users in the evolutionary growth of existing capabilities (95). These factors clearly apply not only to command and control systems, but to joint systems, and to systems acquired under an evolutionary acquisition strategy.

Nevertheless, because evolutionary acquisition offers an opportunity to obtain more test data -- and therefore more timely visibility and information with which to correct performance and support problems -- an evolutionary acquisition strategy makes configuration management more difficult, inventories bigger, modifications more expensive, and schedules longer. These in the end affect program stability and lead to goldplating (like more performance-oriented engineering change proposals) (96).

Consequently, use of an evolutionary acquisition strategy mandates special consideration for those aspects of technical management which control change in systems -- in particular, systems requirements and configuration control (including interface management) (97). The Armed Forces Communications and Electronics Association study team

proposes that special management procedures apply where the unique aspects of evolutionary acquisition manifest themselves, for example in involving users, in managing interfaces, or in developing decision support software (98). Similarly, the guidance promulgated by the Joint Logistics Commanders focuses on a number of key areas requiring special consideration when using an evolutionary acquisition strategy (99).

On the other hand, the Joint Service Acquisition Program Management Study Ad Hoc Group proposes that special management procedures apply by virtue of characteristics unique to joint acquisition programs. These characteristics include the dominance of the Office of the Secretary of Defense and others external to the service, and an ad hoc decision process for jointness (a process that is based primarily on the potential for cost savings and interoperability; yet, a process that is "ad hoc" by nature because this process is without supporting analysis to identify the real potential for cost savings) (100). Without special management procedures in joint acquisition programs, one or more of the participating services often withdraws due to technical requirements differences, cost problems, schedule growth, and low participating service priorities (101).

Alternative Acquisition Strategies

Failure to pursue a clear cut strategy leads to conflicts in planning, procurement, and organization. Other than the traditional life cycle system management model, there are a number of alternative acquisition strategies which do get confused with an evolutionary acquisition strategy. The first, and most common, is pre-planned product improvement (P3I).

Pre-planned product improvement (P3I) is an acquisition strategy often confused with evolutionary acquisition, which has sometimes been defined as a special case of the broader subject, P3I (102). Nevertheless, the major difference between evolutionary acquisition and P3I is that evolutionary acquisition is more process oriented, whereas P3I is more design or hardware oriented. Because the focus of evolutionary acquisition is on command and control systems, the emphasis within evolutionary acquisition is toward software management strategies and system architecture designs. On the other hand, because the focus of P3I is on hardware, the emphasis within P3I is toward preplanning (and even incorporating) hardware design upgrades (for example, increased strength of structural members) (103,104).

A second alternative acquisition strategy confused with evolutionary acquisition is phased acquisition. Sometimes the literature addresses the idea of evolutionary

acquisition as a "phased" acquisition regardless of the distinction between phased, incremental, turnkey, and evolutionary approaches described earlier for command and control system design.

But, an evolutionary acquisition is not a phased acquisition per se. Phased acquisition is appropriate for a technologically advanced, highly complex weapon system for which time is needed to mature the design and provide test information and early production and field deployment experience. For example, the use of low-rate initial production during the transition from full scale development to production and deployment is a common application of phased acquisition (105).

In fact, the Armed Forces Communications and Electronics Association study, Command & Control (C2) Systems Acquisition Study Final Report, states that an evolutionary acquisition strategy to acquire command and control systems has, as a related concomitant, ". . . the elimination of counter-productive official phase distinctions in the early part of a C2 program." (106) The Joint Logistics Commanders' Guide for the Management of Joint Service Programs lists a number of reasons why a phased acquisition may not be appropriate to a joint acquisition program (107).

Common to various alternative acquisition strategies -- whether evolutionary, P3I, phased, and so forth -- is the

element of the acquisition strategy called concurrency (108). Because concurrency has overlapping activities in design, test and evaluation, and production and deployment, risks increase due to uncertainties in achieving performance, schedule, support, and cost objectives. Of course these uncertainties are of concern to a single service acquisition program; but these uncertainties magnify under the lenses used to monitor joint acquisition programs (109).

Closing

Despite the inherent conflicts in the use of an evolutionary acquisition strategy in acquiring command and control systems, evolutionary acquisition does provide a materiel acquisition strategy that addresses a fundamental problem in command and control systems programs -- the hardware and software technologies change at a much faster rate than the traditional acquisition program (110).

Regardless of whether a program is a joint acquisition program or not, inherent conflicts can exist if a program has an evolutionary acquisition strategy. When such conflicts manifest themselves, solutions (irrespective of phased, incremental, or evolutionary approaches) resemble solutions typical of the traditional, or classic, approach to acquisition: maintain stability in funding; perform adequate testing and evaluation; provide for sustainability; adhere to sound procurement practices; anticipate operations

and maintenance problems; implement standard operating procedures; plan for training; use prototyping wisely; and validate, manage, and control intelligently (111).

Summary

To determine whether an evolutionary acquisition strategy is suitable to use in joint acquisition programs for command and control systems, the end of chapter three asks whether there exist criteria in addition to, or in reinforcement of, the Packard Commission's criterion -- an informed trade-off between user requirements, on the one hand, and schedule and cost, on the other. To that end, this chapter examines nine inherent conflicts with an evolutionary acquisition strategy, as each could apply as a test when formulated as a rule or principle. Those inherent conflicts which emerge from examining evolutionary acquisition are: (i) introducing new technology, (ii) increasing user influence, (iii) defining system requirements, (iv) competing funding interests, (v) developing appropriate requirements, (vi) managing system integration, (vii) allowing commander flexibility, (viii) implementing special management procedures, and (ix) using alternative acquisition strategies.

To varying extent, these conflicts with evolutionary acquisition change when oriented on joint acquisition; yet still, these conflicts reinforce the soundness in relying on the Packard Commission's criterion as a basis for program

success. This is due in large part because that list of "inherent conflicts" in evolutionary acquisition addresses a number of other important considerations, heretofore ignored by the various policies. Superimposing the difficulties characteristic of joint acquisition programs simply compounds any existing inherent conflicts, unless, of course, the acquisition strategy accounts for these conflicts. Chapter five discusses the effect these inherent conflicts have relative to the Packard Commission's criterion, concludes this study by applying appropriate criteria to answer the introductory purpose, and offers a number of recommendations for further study in these related subject areas.

CHAPTER 4 -- ENDNOTES

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- 40Kelly Campbell, Military Systems Acquisition in the NATO Market (New York, NY: Frost and Sullivan, Inc., 1985), pp. xx-xxi, 44, 54, 55.
- 41DOD Directive Number 4630.5. op. cit., p. 2. A requirement is an established need justifying the timely

allocation of resources to achieve a command and control, telecommunications, or intelligence capability to accomplish approved military objectives, missions, or tasks.

42Joint Chiefs of Staff, Secretary's Memorandum 7-82, "Policy and Procedures for Management of Joint Command and Control Systems," 11 January 1982, pp. 1-2. The requirements process exists through procedures providing common channels and documents establishing specific objectives, identifying deficiencies, translating the deficiencies into statements of requirements, validating requirements, recommending approval for the implementation, monitoring the implementation, and evaluating performance.

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(Memorandum of Agreement on Multiservice Operational Test
and Evaluation (MOT&E) and Joint Test and Evaluation (JT&E),
15 May 1986). The operational testing community has found
it necessary to make a specific distinction between JT&E and
MOT&E. The commanders of the services' independent
operational test organizations have agreed that JT&E means

an Office of the Secretary of Defense (OSD)-directed
T&E program structured to evaluate system
operational or technical performance under realistic
conditions with two or more Services participating

or with interrelated/interacting systems for the purpose of
providing information required by Congress, OSD, Commanders
of Unified and Specified Commands, or DOD components. MOT&E
means

OT&E conducted by two or more Services for systems
to be acquired by more than one Service, or for a
Service's systems which have interfaces with
equipment of another Service.

This distinction was made to allow the service test
organizations to differentiate between their acquisition-
oriented test activity and that mandated by DOD Directive
5000.3 under the direction of the Director, Operational Test
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102BDM Corporation, "New Approaches for C3I Systems Acquisition." Signal 36.11 (August 1982), pp. 55-57. In this panel discussion sponsored by BDM Corporation, Mr John Smith (Director, Major Systems Acquisition, Office of the Secretary of Defense) declared that his office considers "evolutionary acquisition a special case of the primary and ongoing thrust of P3I . . . [which] is mandated and facilitated in our DOD Instruction 5000.2." Defense Acquisition Circular #76-43 has some of that tone. On the

other hand, both the 1982 Armed Forces Communications and Electronics Association study (p. I-24) and the 1987 Joint Logistics Commanders guidance on evolutionary acquisition (p. 3) reject classifying evolutionary acquisition as a subset of P3I.

103Captain Philip T. Mackey, USAF, Pre-Planned Product Improvement: A Better Way of Weapon System Acquisition?, Thesis (Wright-Patterson AFB, OH: Air Force Institute of Technology, 1984), pp. 36-38. On page 37 Captain Mackey also writes, "One could say that the EA [evolutionary acquisition] process 'pulls' technology to meet its final goal, and that P3I allows technology to 'push' its systems requirements." The Packard Commission cautions, however, "Both methods ['user pull' and 'technology push'] are unsatisfactory." (Committee on Armed Services, United States House of Representatives, 100th Congress, Defense Acquisition: Major U.S. Commission Reports (1949-1988) (Washington, DC: GPO, 1 November 1988), p. 927. Reference here is to the Packard Commission (1986): A Quest for Excellence -- Final Report to the President by the President's Blue Ribbon Commission on Defense Management.)

104Acquisition Strategy Guide (Fort Belvoir, VA: The Defense Systems Management College, July 1984), p. 5-49.

105Ibid., p. 5-43.

106Armed Forces Communications and Electronics Association, op. cit., p. III-38.

107Joint Logistics Commanders, Guide, op. cit., pp. 4-15, 4-16.

108Acquisition Strategy Guide (Fort Belvoir, VA: The Defense Systems Management College, July 1984), p. 5-14. Concurrency in DOD is generally placed in the context of the overlap of activities constituting at least part of full scale development, transition to production, achievement of production rate, and initial deployment of the system. Concurrency can also occur through elimination of a phase or overlapping of phases in the acquisition process.

109Ibid., pp. 4-5, 4-6, 4-7.

110Zawilski, op. cit.

111BDM Corporation, "Evolutionary C2--A Field Report," Signal 40.12 (August 1986), pp. 74-75. In this panel discussion sponsored by BDM Corporation, the speaker is Colonel Alan D. Campen, USAF (Ret.).

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Introduction

The purpose of this study is to determine the suitability of using an evolutionary acquisition strategy in joint acquisition programs for command and control systems. This chapter draws conclusions based upon the criteria presented in chapter three and upon those criteria determined relevant in chapter four, and makes recommendations depending upon those conclusions.

To do that, this study examined the unique circumstances of joint acquisition programs and compared these circumstances with analogous circumstances relative to an evolutionary acquisition strategy applied to command and control systems.

Chapter one provided an overview of the nature of command and control systems and of the related acquisition strategy of evolutionary acquisition. Chapter two reviewed the major DOD studies pertinent to command and control systems management and to joint acquisition program management. Chapter three examined the rationale for both evolutionary acquisition and joint acquisition and concluded with criteria relevant to implementing an evolutionary

acquisition strategy or to establishing a joint acquisition program. To see whether other criteria emerge, chapter four, using nine "inherent conflicts" in evolutionary acquisition, examined whether they, too, serve as additional criteria in determining how suitable the use of an evolutionary acquisition strategy is in joint acquisition programs for command and control systems.

The summary to chapter two pointed out that evolutionary acquisition, as an acquisition strategy, is neither widely used nor well understood. It is, in fact, so unknown to joint acquisition programs that the basic guide to joint acquisition programs omits any mention of evolutionary acquisition. Yet, one common thread between an evolutionary acquisition "strategy" and a joint acquisition "program" is that both have unique modifications to the normal practices of systems acquisition. Are these unique modifications compatible?

Chapter three answered that question to the contrary by presenting in a straight-forward manner some of the unique circumstances and modifications common to evolutionary acquisition, the "strategy," and joint acquisition, the "program." Thereafter, chapter three concluded that there is one criterion, the Packard Commission's, for success in program acquisition -- an informed trade-off between user requirements, on the one hand, and schedule and cost, on the other. This criterion

provided the basis for deciding if an evolutionary acquisition strategy is suitable for use in a joint acquisition programs for command and control systems. But was this a sufficient basis?

Chapter four examined if other criteria exist in addition to, or in reinforcement of, the Packard Commission's criterion. To that end, chapter four focused on nine inherent conflicts with an evolutionary acquisition strategy. These conflicts were: (i) introducing new technology, (ii) increasing user influence, (iii) defining system requirements, (iv) competing funding interests, (v) developing appropriate requirements, (vi) managing system integration, (vii) allowing commander flexibility, (viii) implementing special management procedures, and (ix) using alternative acquisition strategies. To varying extent (as set forth in the next section), these conflicts changed when oriented on joint acquisition programs and, in general, reinforced the Packard Commission's criterion.

Conclusions

This study has two conclusions. First, the Packard Commission's criterion -- an informed trade-off between user requirements, on the one hand, and schedule and cost, on the other -- is (of the several sets of criteria presented) the only one upon which to base a decision on the research question. Second, on the research question itself -- the suitability of using an evolutionary acquisition strategy in

joint acquisition programs for command and control systems -- based on the Packard Commission's criterion, the conclusion is: No, an evolutionary acquisition strategy is not suitable to use in joint acquisition programs for command and control systems. The remainder of this section elaborates on the rationale for these two conclusions.

The first of this study's two conclusions is that the Packard Commission's criterion is the only criterion (of the several sets of criteria presented) upon which to decide if an evolutionary acquisition strategy is suitable to use in joint acquisition programs for command and control systems. This is because of the Packard Commission's emphasis on program success.

As chapter three showed, both an evolutionary acquisition strategy and a joint acquisition program have criteria to be used to decide whether to implement such a "strategy" or to establish such a "program." Each remains appropriate within its own context, but not necessarily so when the context changes (as using an evolutionary acquisition strategy on a joint acquisition program, or as executing a joint acquisition program for command and control systems).

For example, the criteria for an evolutionary acquisition approach do not anticipate the three hallmarks for program success -- cost, schedule, performance -- just performance. Somehow within the context of a single

service, cost and schedule adjustments occur with controllable ripples. That is not true for a joint acquisition program. For the opposite example, the criteria for a joint acquisition approach do not anticipate fully command and control systems' unique characteristics requiring some user involvement. Somehow, too, within the context of a single service, performance adjustments (during command and control systems acquisition) occur through controllable iterations with the user. Due to cost and schedule constraints imposed by the services in a joint acquisition program, that is not true for an evolutionary acquisition approach.

Consequently, neither the criteria appropriate to deciding on the use of an evolutionary acquisition approach nor the criteria appropriate to deciding on the initiation of a joint acquisition approach appeared completely satisfactory to use to decide the research question of this study. The criterion of the Packard Commission, however, appeared to represent a viable basis to use to decide the research question because that criterion captured each of the missing elements to the other two sets of criteria.

Did that criterion represent a sufficient basis to determine the suitability of using an evolutionary acquisition strategy in joint acquisition programs for command and control systems? To see if other criteria emerge, chapter four, using nine "inherent conflicts" in

evolutionary acquisition, examined whether they, too, serve as additional criteria, or simply reinforce the criterion established by the Packard Commission.

Most of the nine inherent conflicts with an evolutionary acquisition strategy substantially reinforce the Packard Commission's criterion relative to joint acquisition programs; and the remaining ones reinforce the Packard Commission's criterion to a lesser degree on whether evolutionary acquisition should be used in joint acquisition programs.

The first inherent conflict (introducing new technology) reinforces the Packard Commission's criterion upon which to judge the use of an evolutionary acquisition strategy in a joint acquisition program from the standpoint of the need for a "tradeoff." As chapter four points out, introducing new technology has inherent risks to the developer. Joint acquisition program successes seem to occur at the subsystem, component, and technology base level rather than at the system level -- where the focus exists for an evolutionary acquisition strategy for command and control "systems." A forte of evolutionary acquisition is the system-level introduction of new technology -- yet, constant introduction of new technology at the system level leads to unsuccessful joint acquisition programs. Hence, there is an absolute need to tradeoff to couple favorable evolutionary acquisition features (like prototyping and

testing, and communications with users) with analogous features associated with successful joint acquisition programs (like program stability).

The next four inherent conflicts (increasing user influence, defining system requirements, competing funding interests, and developing appropriate requirements) reflect subsets of the Packard Commission's criterion.

Consequently, these inherent conflicts serve to reinforce what the Packard Commission determined. When the Packard Commission refers to "user requirements," the inference addresses two of these four inherent conflicts (increasing user influence and defining system requirements).

Similarly, when the Packard Commission refers to "cost and schedule," the inference here addresses the remaining two of these four inherent conflicts (competing funding interests and developing appropriate requirements) because schedule implicitly includes problems in terms of the time the requirements process takes.

The remaining four inherent conflicts (managing system integration, allowing commander flexibility, implementing special management procedures, and using alternative acquisition strategies) also reinforce the Packard Commission's criterion for a decision, but not to a significant degree. If anything, the remaining four inherent conflicts illustrate the constraints upon the program manager in trying to execute an evolutionary

acquisition strategy in a joint acquisition program for command and control systems. What makes the Packard Commission's criterion a more definitive statement than these four represent is the concept of a "tradeoff." Just as a fundamental "ility" of command and control systems is "interoperability," so, too, is the need for the relevant factors for any decision to "interoperate" or "tradeoff" with the other relevant factors.

Therefore, the first major conclusion of this study is that the criterion used to decide whether an evolutionary acquisition strategy is suitable to use in joint acquisition programs for command and control systems should be "Is program success based on an informed tradeoff between user requirements, on the one hand, and cost and schedule, on the other?"

The second of this study's two conclusions regards the research question itself -- the suitability of using an evolutionary acquisition strategy in joint acquisition programs for command and control systems. Based on the Packard Commission's criterion above, the conclusion is: No, an evolutionary acquisition strategy is not suitable to use in joint acquisition programs for command and control systems.

This study provides insufficient evidence that joint acquisition programs for command and control systems would be successful under an evolutionary acquisition strategy

given an informed tradeoff between user requirements, on the one hand, and cost and schedule, on the other. In other words, the conclusion of this study is that evolutionary acquisition, as an alternative acquisition strategy to acquire command and control systems, is not useful for joint acquisition programs.

Even given that evolutionary acquisition does not attempt to deal with problems common to all acquisition programs, the crux of the choice in determining whether to use an evolutionary acquisition strategy rests on an indefinite state of requirements. There is, too, some concern about commitment, since the user basically is not satisfied with the completeness of the requirements specification. Consequently, there exists little basis for an informed tradeoff if the requirements cannot be made more definitive; for rapid, extensive requirements changes deter joint service commitment since the changes look like a blank check to goldplate.

Quite the opposite occurs with a decision to support a joint acquisition program. For a successful joint acquisition program the requirements must be resolved; there must be a firm basis for commitment; and there must be a net cost benefit. At this point applying the Packard Commission's criterion shows little agreement in supporting a decision to use an evolutionary acquisition strategy in a joint acquisition program. No tradeoff can really occur

when the user hedges on commitment, when the requirements remain relatively undefined, or when an estimate cannot be made as to ultimate cost. The basis for a successful program does not exist.

Further, in some respects even what leads to "program success" differs conceptually between evolutionary acquisition and joint acquisition. The introduction of new technology is one example. Without new technology in hand, the success rate for joint acquisition programs is not there. That is a basic incompatibility with using an evolutionary acquisition strategy, which anticipates forthcoming, not-yet-in-hand technology. The perspective on time is another example. The nature of an evolutionary acquisition strategy is inherently to stretch the schedule; the nature of a joint acquisition program is inherently to fight any schedule stretches to retain program advocacy.

Finally, acquisition strategies which increase risks due to uncertainties in achieving performance, schedule, support, and cost objectives are not suitable for use in joint acquisition programs for command and control systems. This study concludes that because evolutionary acquisition is an alternative acquisition strategy that introduces such risks, an evolutionary acquisition strategy is not suitable for use in joint acquisition programs for command and control systems.

Recommendations

This study has two recommendations. First, the policies relative to evolutionary acquisition and the policies relative to joint acquisition must consider the effects of each. That is, any evolutionary acquisition policy must consider the unique challenges faced by a joint acquisition program; and the corollary -- any joint acquisition policy affecting command and control systems must consider the special attributes of these systems. Second, since the rules for an evolutionary approach do not accommodate the day-to-day realities of program management, further study must focus on how to make the accommodation happen.

The first of this study's two recommendations is that the policies in these two areas must consider the effects of each. That is, any evolutionary acquisition policy must consider the unique challenges faced by a joint acquisition program (even to the extent of specifying that the policy is inappropriate here); and the corollary, any joint acquisition program policy affecting command and control systems must consider the special attributes of these systems.

For example, current evolutionary acquisition policy, represented by the Joint Logistics Commanders Guidance for the Use of an Evolutionary Acquisition (EA) Strategy in Acquiring Command and Control (C2) Systems, does

not consider the unique challenges of joint acquisition programs. Two of the big problems in the execution of joint programs involve maintaining program stability and harmonizing service business practices. Yet, the policy on use of an evolutionary acquisition strategy ignores recommended solutions to each, like standardizing business practices and baselining (a technique used to enhance stability and control cost growth). Indeed, baselining seems to counteract an evolutionary acquisition policy; ergo, any evolutionary acquisition strategy policy must address this seeming incompatibility. Similarly, the demands of an evolutionary acquisition policy for modifications to the normal way of doing business run counter to standardizing practices between the services. So, any evolutionary acquisition strategy policy must address what the services should do in joint acquisition programs (even as this study concludes, to avoid the joint acquisition programs).

On the other hand, any policies developed to address joint acquisition programs, represented here, for instance, by the Joint Logistics Commanders' Guide for the Management of Joint Service Programs, must consider the special attributes of command and control systems. The principal illustration is the disconnect between the way requirements are developed for command and control systems verses other weapons systems. The continuous, and changing, nature of

these requirements means a continuous, and changing, problem for any joint acquisition program and for any functionally related organization (logistics agencies, test agencies, etc.). For example, the joint command and controls systems environment has organizations like the Joint Tactical Command, Control, and Communications Agency in the tactical arena or the Systems Integration Office in the strategic arena which together complicate the classic test structure. Current joint acquisition guides remain silent on the effect of these added participants. Another example is the development-like process verses production-line process inherent in command and control systems verses other weapons systems. Joint acquisition program procedures remain inadequate to deal with such command and control system facts-of-life. Again, another illustration is that the development-like characteristics of command and control systems include the role of architecture and standards, which shift the focus for any joint acquisition program if systems can interoperate through an agreed architecture and a set of standards.

The second of this study's two recommendations is that since the rules for an evolutionary approach do not accommodate the day-to-day realities of program management, further study must focus on how to make the accommodation happen. (If evolutionary acquisition remains a viable acquisition strategy for a joint acquisition programs for

command and control systems, then the rules and procedures and practices must be adopted to recognize the connection between an evolutionary acquisition strategy and its use in a joint acquisition program for command and control systems.)

For example, both the 1978 and the 1987 Defense Science Board (DSB) task force reports on command and control systems management recommend an evolutionary approach to command and control systems acquisition. Yet, little evidence exists on implementing those recommendations, even though the 1987 DSB task force echoed in large part that of the 1978 DSB task force, almost eleven years ago. For instance, the 1978 DSB task force had five broad recommendations. Of the five, two called for strengthening the capabilities of the unified and specified commands. Similarly, the 1987 DSB task force had six recommendations. Of the six, three recommended strengthening the capabilities of the unified and specified commands. As nothing to date has been done on implementing those recommendations, how to implement those recommendations represents a necessary area for further study.

For another example, there exist no measurement systems or data to assess the long-term effect of an evolutionary acquisition policy to enable an informed tradeoff between user requirements and cost and schedule.

(For joint acquisition programs, adequate information exists.)

A third example for further study is the need for adequate study on what further guidance to provide to the field. The Joint Logistics Commanders Guidance for the Use of an Evolutionary Acquisition (EA) Strategy in Acquiring Command and Control (C2) Systems contains a number of areas requiring special consideration when using evolutionary acquisition. These areas need review from the joint acquisition perspective, regardless of whether an evolutionary acquisition strategy is used in a joint acquisition program for a command and control system. Similarly, the Joint Logistics Commanders' Guide for the Management of Joint Service Programs needs review from the perspective of command and control systems, since that guide should minimally address the Joint Logistics Commanders' own evolutionary acquisition policy.

A final area for further study is the need to emplace a requirements process to lay the foundation for the use of any acquisition strategy in joint acquisition programs. Most agencies have inadequate means to bring together consensus on joint command and control requirements. Current requirements procedures of the Joint Chiefs of Staff, for example, remain too cumbersome to build joint commitment and too unresponsive to support an evolutionary approach.

Summary

Command and control systems acquisition remains a difficult area. In joint acquisition programs for command and control systems, without a bona fide mechanism for insuring the commitment of the large numbers of disparate players, novel approaches such as an evolutionary acquisition strategy only introduce risk into the program, complexity into the organizations and their procedures, and as a result, destabilize these joint acquisition programs. As this study shows, joint acquisition programs cannot afford that. Rather, they have to resolve up front requirements, cost, schedule, funding, and organization. If this does not occur, joint acquisition programs for command and control systems may have to adopt an alternative approach like one based on architecture and standards in which each service participant would be free to balance cost and performance as necessary to achieve interoperability (and yes, to evolve at each service's own discretion).

The first conclusion of this study shows that "Is program success based on an informed tradeoff between user requirements, on the one hand, and cost and schedule, on the other?" is a valid criterion to ascertain whether an evolutionary acquisition strategy is suitable for use in joint acquisition programs for command and control systems. Similarly, the second conclusion shows that applying that criterion leads to the conclusion -- No, an evolutionary

acquisition strategy is not suitable for use in joint acquisition programs for command and control systems.

That conclusion agrees with the findings within NATO command and control systems acquisition and, most recently, within WWMCCS (Worldwide Military Command and Control System) systems acquisition. The recommendations of this study address the need for policy applicable both to an evolutionary acquisition strategy and to a joint acquisition program to consider the attributes of each other, and if need be, to consider the mechanisms necessary to implement each in conjunction with the other.

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